SCIENCE

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THE CONTRIBUTION OF THE CHEMIST TO THE INDUSTRIAL DEVELOPMENT OF THE UNITED STATES[1]

SINCE the outbreak of the European War, the American public has been led, adroitly or otherwise, to believe that industrial chemistry, that is, the industrial activity of the chemist, is limited to coal-tar dyes and that nothing should be regarded as industrial chemistry that does not deal with the manufacture of these dyes. Nothing could be further from the truth.

While it is true that the manufacture of coal-tar dyes forms an important branch of industrial chemistry, or of chemical industry, whichever you will, it by no means forms the whole of it or even a preponderating part of it.

From the economic point of view, economic effect and economic result is the measure to apply in determining economic importance and not the intellectual or scientific labor involved in the creation of that result.

From a strictly economic point of view coal-tar dyes can hardly be said to be vital or essential and by that I mean that we can get along without them and not suffer great hardship, personal or otherwise; anything of less need than that can hardly be called an economic necessity.

THE CHEMIST AND HIS WORK

The American public has seemingly given too little consideration to those industries of this country that make use of chemical knowledge and experience in the

[1] From the public address at the fiftieth meeting of the American Chemical Society, New Orleans, March 31 to April 3, 1915.

manufacture or utilization of products and yet these are the ones that compose chemical industry or industrial chemistry.

For the present, permit me to give in a few words the substance of the impressive series of papers presented at the meetings of this forenoon and this afternoon, and, as this presentation is being made, please have in mind the question as to whether you would prefer to have the United States able to produce all of its requirements of coal-tar dyes and *not* able to produce any of the various things which I am about to mention.

According to this symposium there are at least nineteen American industries in which the chemist has been of great help, either in founding the industry, in developing it, or in refining the methods of control or of manufacture, thus rendering profit more certain, costs less high and output uniform in standard amount and quality.

The substitution of accurate, dependable and non-failing methods of operation for "rule of thumb" and "helter-skelter" methods must appeal to every manufacturer as a decided advancement and a valuable contribution.

NINETEEN AMERICAN CHEMICAL INDUSTRIES

In presenting to you these various contributions of the chemist, I by no means wish to be understood as in any wise minimizing or reducing the contributions made to the final result by others, such as merchants, bankers, engineers, bacteriologists, electricians, power-men and the like; all that I wish to emphasize is that the chemist *did* make a contribution, and to that extent he is entitled to credit and acknowledgment.

The chemist has made the *wine industry* reasonably independent of climatic conditions; he has enabled it to produce substantially the same wine, year in and year out, and no matter what the weather; he has reduced the spoilage from 25 per cent. to 0.46 per cent. of the total; he has increased the shipping radius of the goods and has made preservatives unnecessary.

In the *copper industry* he has learned and has taught how to make operations so constant and so continuous that in the manufacture of blister copper valuations are less than $1.00 apart on every $10,000 worth of product and in refined copper the valuations of the product do not differ by more than $1.00 in every $50,000 worth of product. The quality of output is maintained constant within microscopic differences.

Without the chemist the *corn products industry* would never have arisen and in 1914 this industry consumed as much corn as was grown in that year by the nine states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey and Delaware combined; this amount is equal to the entire production of the state of North Carolina and about 80 per cent. of the production of each of the States of Georgia, Michigan and Wisconsin; the chemist has produced over 100 useful commercial products from corn, which, without him, would never have been produced.

In the *asphalt industry* the chemist has taught how to lay a road surface that will always be good, and he has learned and taught how to construct a suitable road surface for different conditions of service.

In the *cottonseed oil industry,* the chemist standardized methods of production, reduced losses, increased yields, made new use of wastes and by-products and has added somewhere between $10 and $12 to the value of each bale of cotton grown.

In the *cement industry,* the chemist has ascertained new ingredients, has utilized theretofore waste products for this pur-

pose, has reduced the waste heaps of many industries and made them his starting material; he has standardized methods of manufacture, introduced methods of chemical control and has insured constancy and permanency of quality and quantity of output.

In the *sugar industry,* the chemist has been active for so long a time that "the memory of man runneth not to the contrary." The sugar industry without the chemist is unthinkable.

The *Welsbach mantle* is distinctly a chemist's invention and its successful and economical manufacture depends largely upon chemical methods. It would be difficult to give a just estimate of the economic effect of this device upon illumination, so great and valuable is it.

In the *textile industry,* he has substituted uniform, rational, well thought-out and simple methods of treatment of all the various textile fabrics and fibers where mystery, empiricism, "rule of thumb" and their accompanying uncertainties reigned.

In the *fertilizer industry,* it was the chemist who learned and who taught how to make our immense beds of phosphate rock useful and serviceable to man in the enrichment of the soil; he has taught how to make waste products of other industries useful and available for fertilization and he has taught how to make the gas works contribute to the fertility of the soil.

In the *soda industry,* the chemist can successfully claim that he founded it, developed it, and brought it to its present state of perfection and utility, but not without the help of other technical men; the fundamental ideas were and are chemical.

In the *leather industry,* the chemist has given us all of the modern methods of mineral tanning and without them the modern leather industry is unthinkable. In the case of vegetable-tanned leather he has also stepped in, standardized the quality of incoming material and of outgoing product.

In the *flour industry* the chemist has learned and taught how to select the proper grain for specific purposes, to standardize the product and how to make flour available for certain specific culinary and food purposes.

In the *brewing industry,* the chemist has standardized the methods of determining the quality of incoming material and of outgoing products, and has assisted in the development of a product of a quality far beyond that obtaining prior to his entry into that industry.

In the *preservation of foods,* the chemist made the fundamental discoveries; up to twenty years ago, however, he took little or no part in the commercial operations, but now is almost indispensable to commercial success.

In the *water supply of cities,* the chemist has put certainty in the place of uncertainty; he has learned and has shown how, by chemical methods of treatment and control, raw water of varying quality can be made to yield potable water of substantially uniform composition and quality.

The *celluloid industry,* and the *nitrocellulose industry,* owe their very existence and much of their development to the chemist.

In the *glass industry* the chemist has learned and taught how to prepare glasses suitable for the widest ranges of uses and to control the quality and quantity of the output.

In the *pulp and paper industry* the chemist made the fundamental observations, inventions and operations and to-day he is in control of all the operations of the plant itself; to the chemist also is due the cheap production of many of the materials enter-

ing into this industry as well as the increased and expanding market for the product itself.

THE STATISTICAL POSITION

For the census year of 1909 the wage-earners and the value of manufactured products and the value added by manufacture in twelve of these industries and in the manufacture of chemicals is given in Table I*a*.

this amounts to about 15 cents per person per year.

Now, which would you rather have, these thirteen industries with their $2,500,000,000 worth of manufactured product or the coal-tar dye industry with its $100,000,000 of product? The number of persons employed in these above thirteen industries is in excess of 500,000; the entire world's supply of coal-tar dyes is made by fewer than 40,000 people. Which would you rather have?

TABLE I*a*

	Wage-earners	Product Value	Value Added by Manufacture
Wine	1,911	$13,120,846	$6,495,313
Copper	15,628	378,805,974	45,274,336
Fertilizer	18,310	103,960,213	34,438,293
Textiles	44,046	83,556,432	48,295,131
Canned and preserved foods	59,968	157,101,201	55,278,142
Cotton-seed oil	17,071	147,867,894	28,034,419
Cement	26,775	63,205,455	33,861,664
Sugar	20,730	327,371,780	52,523,806
Brewing	54,579	374,730,096	278,134,460
Leather	62,202	327,874,187	79,595,254
Glass	68,911	92,095,203	59,975,704
Paper and wood pulp	75,978	267,656,964	102,214,623
Chemicals (strictly)	23,714	117,688,887	53,567,351
Totals	529,823	$2,455,035,132	$897,688,496

TABLE I*b*

Iron and steel	278,505	$1,377,151,817	$399,013,072
Petroleum refining	13,929	236,997,659	37,724,257
Lead smelting and refining	7,424	167,405,650	15,442,628
Illuminating and heating gas	37,215	166,814,371	114,386,257
Confectionery	44,638	134,795,913	53,645,140
Paint and varnish	14,240	124,889,422	45,873,867
Soap	12,999	111,357,777	39,178,359
Carpets and rugs	33,307	71,188,152	31,625,148
Explosives	6,274	40,139,061	17,328,113
Zinc smelting and refining	6,655	34,205,894	8,975,893
Turpentine and resin	39,511	25,295,017	20,384,174
Oil cloth and linoleum	5,201	23,339,022	7,788,921
Chocolate and cocoa	2,826	22,390,222	8,867,162
Baking powder and yeast	2,155	20,774,588	11,436,603
Dyestuffs and extracts	2,397	15,954,574	6,270,923
Blacking, cleansing and polishing preparations	2,417	14,679,120	7,716,728
Wood distillation other than turpentine	2,721	9,736,998	3,861,147
Oleomargarine	606	8,147,629	1,650,997
Totals	513,020	$2,605,262,886	$829,052,389
Total for 31 chemical industries	1,042,843	$5,060,298,015	$1,726,740,885
Total for all industries	6,615,046	$20,672,051,870	$8,529,260,992

AMERICAN INDUSTRIES VS. COAL-TAR DYES

A most liberal estimate of the market value of the world's entire production of coal-tar dyes places it under $100,000,000; the entire consumption in the United States is less than $15,000,000, duty included, and

These thirteen industries employ 8 per cent. of all wage-earners in manufacturing enterprises in the United States, produce 12 per cent. of the total value of manufactured product and 10.5 per cent. of the total value added by manufacture. In

other words, the chemist engaged in these thirteen pursuits plays an important, if not indispensable part in the lives of 8 per cent. of our wage-earners and affects 12 per cent. of our manufacture-values and 10.5 per cent. of our values added by manufacture. But the total number of chemists makes up only about 0.01 per cent. of the population of the United States.

NO NATION CAN DO EVERYTHING ITSELF

Of course, it may be said that having made all these other things, there is no excuse why the American should not make coal-tar dyes in addition. Perhaps so; but nations, like individuals, can not each have or do everything. If each nation could do everything equally as well as every other nation, there would be no occasion whatever for international business. As this world is constituted, each nation does that which it can do the best and trades off the product for what some other nation can do better than it, and both sides are satisfied and make a profit; this is the same as the relationship between individuals. The shoemaker can make shoes better than he can bake bread; he makes shoes and exchanges part of his income with the baker for bread which the baker has made.

If American chemists can operate these industries better than or as well as other nations, it is no real ground for criticism that they can not do everything better than any other nation, any more than the shoemaker is to be criticized because he can not make as good a suit of clothes as can the tailor. If you want the shoemaker to be able to make a suit of clothes as well as the tailor you must provide him with the opportunity to learn how to tailor and take care of him while he is learning, and no doubt his suit of clothes will cost him more than it would cost an established tailor to turn out the same kind of a suit of clothes, and you must again help your shoemaker while he is trying to market his suit of clothes against the established tailor.

EIGHTEEN ADDITIONAL AMERICAN CHEMICAL INDUSTRIES

The above nineteen American industries referred to by no means comprise all the American industries in which the chemist can be of help and of assistance. Many more are open.

A search through the census for 1909 discloses the eighteen additional industries listed in Table I*b* which make use of chemists in the control of their operations.

In these eighteen additional industries the chemist affects 8 per cent. of our wage-earners, 12.6 per cent. of our manufacture values and 9.7 per cent. of our values added by manufacture. For these thirty-one industries, then, the 0.01 per cent. of chemists of our population directly affect 16 per cent. of our wage-earners, 24.6 per cent. of our manufacture values and 20.2 per cent. of our values added by manufacture.

This, therefore, is a measure of the influence of the chemist upon the industrial development of the United States; however gratifying this result is, it is nevertheless true that many other industries could employ chemical control to great advantage, if they only would, and many establishments under the above cited industries could, if they would, make use of chemical control. There is plenty of work left for the chemist to do in these industries to keep him fully and profitably engaged. This being so, why should he not continue to direct his energies to improving those things that he already can do, rather than attempt new and exotic things which others can do better than he?

THE FOREIGN BUSINESS

So much for our internal relations. How about our international relations? To an-

swer this question I will use the official classification of the German government as to what constitutes products of and for chemical industry and also the same government's corresponding figures for 1913.

No two countries, speaking through their statistical departments, have the same working definition of chemical industry. None of the official classifications is as comprehensive as is the official German classification. So far as the exchange of products and commodities involved in chemical pursuits is concerned, the German classification shows a total of 442 items of which 229 are involved in international trade between Germany and the United States. According to these figures and this classification, the United States imported from Germany in 1913, $60,860,880, and exported to Germany $156,036,090, or a total business of $216,896,970, with a balance in favor of the United States of $95,175,210. I have selected from this 1913 list of items of business between Germany and this country those whose gross is $400,000 per annum or over (Table II).

It is interesting to note that we sell Germany more lard than Germany sells us of potash and aniline and other coal-tar dyes put together; that we sell Germany half again as much refined petroleum as it sells us aniline and other coal-tar dyes; that we sell Germany practically the same amount of pig and scrap lead as Germany sells us of alizarin and anthracene dyes; that we sell Germany almost as much paraffine as Germany sells us of indigo; and so on through the list.

RELATIVE QUALITIES OF IMPORTS AND EXPORTS

Of course, it will be contended that the things that we sell Germany are, from a chemical point of view, less refined, *i. e.*, involve less hard chemical intellectual work than do our imports from Germany. But, is most of the potash, which is practically mined from the ground in Germany, any more of a refined product than the phosphate rock we sell them? Does it not involve quite as much chemical ingenuity to produce good illuminating oil from petroleum as it does to produce many of the coal-tar dyes? There is no question that the general position above outlined is correct, namely, that our products, as a whole, are less refined than those that we get, as a whole, from Germany, but is that not true practically throughout our entire export and import business? Are not the textiles we export of a lower grade than those we import? Are not our leather products less refined than those we buy? And so on down the list. That being so, why pick out the chemist as a special mark for criticism when he is at least up to the average of his surroundings?

In 1913 the total foreign business of the United States amounted to $4,277,348,909, and the excess of exports of all kinds over imports of all kinds amounted to $691,271,949.

The trade in chemicals and products of and for chemical industry between the United States and Germany in 1913 furnished 5 per cent. of that total of international business and provided 13.8 per cent. of the balance of trade.

THE INFLUENCE OF THE CHEMIST

The symposium of papers presented today constitutes a record of proud achievement, of solid accomplishment in nineteen different branches of American industrial activity, to which advance the application of chemical knowledge, chemical principles and chemical experience by American chemists, has contributed a noble share and an effective part. It is perhaps true that much of that progress would have come without the American chemist, but it is

TABLE II

U. S. Chemical Trade with Germany (1913)

U. S. Imports from Germany	Value in U. S. Money	U. S. Exports to Germany
	$75,000,000	1 Copper
	26,700,000	2 Lard
1 Potash salts	18,819,000	
	12,690,000	3 Refined petroleum
2 Aniline and other coal-tar dyes	7,290,000	
	4,970,000	4 Phosphate rock
	4,880,000	5 Oleomargarine
	4,585,000	6 Turpentine rosin
	4,460,000	7 Mineral lubricants
	3,840,000	8 Spirits turpentine
3 Caoutchouc	2,582,000	
	2,220,000	9 Crude benzine
	2,171,000	10 Beef tallow (prime)
	1,744,000	11 Nickel and nickel coin
4 Straw, esparto and other fibers; paper stock	1,649,000	
	1,550,000	12 Cotton-seed oil
5 Alizarin and anthracene dyes	1,463,000	
	1,421,000	13 Pig lead and scrap
6 Indigo	1,319,000	
	1,231,000	14 Crude and hard paraffin
	1,162,000	15 Acetate of lime
7 Platinum and allied metals	1,120,000	
8 Hops	952,000	
9 Miscellaneous volatile oils	941,000	
	903,000	16 Tin and tin scrap
10 Tin and tin scrap	900,000	
11 Potassium and sodium cyanide	845,000	
12 Chrome, tungsten, etc.	784,000	
13 Superphosphates	766,000	
	724,000	17 Crude wood alcohol
14 Beet sugar, refined	716,000	
	695,000	18 Carbides
	673,000	19 Miscellaneous volatile oils
15 Alkaloids exc. quinine	672,000	
16 Toilet and tooth powders	658,000	
	656,000	20 Heavy benzine and patent naphtha
17 Lime-nitrogen, etc.	635,000	
18 Potash carbonate	632,000	
	617,000	21 Lubricants of fats and oils
	579,000	22 Beef and mutton tallow
19 Ferro-Al, Cr, Mn and Ni	567,000	
20 Potassium magnesium sulfate	509,000	
21 Gold ores	506,000	
	506,000	23 Copper alloys
22 Beet sugar, raw	492,000	
23 Aniline oil and salt	476,000	
24 Bronze and metal colors	473,000	
25 Glue	471,000	
26 Aluminum plates and metal	454,000	
27 Quinine and its salts	436,000	
	422,000	24 Portland cement
28 Terpineol and allied synthetics	409,000	
29 Gelatin	403,000	

equally true that under those conditions the advance would have been much slower and also much of what has been accomplished would never have happened at all without the faithful, enthusiastic and alert cooperation of the American chemists on the job. With such a record, the American chemist can hold up his head with pride and self-confidence, firm in the belief, and warranted in his conviction that he has done

a man's work, in a man's way, that he has not been an idler, nor a sloth, nor a drone, but that he has been one of the busiest of busy workers, with a keen eye and an alert intellect, always searching for an opportunity for the betterment of his industry, and for improvement of the conditions of his fellowman.

GERMAN SUPREMACY

That the chemist has not done more is by no means due to any unwillingness. It is due in the largest part to the apathetic attitude of those in charge of the management of many of our industrial enterprises requiring chemical knowledge in their exploitation. Many of these men in responsible positions do not have a chemical education even along the lines in which they are financially active. In those cases chemical novelties and chemical problems are not passed upon, on their merits, by chemists or by men with a chemical point of view, but by merchants, by lawyers and by bankers, men who, by their very training, are not capable of taking the chemist's point of view, of having the chemist's sense of proportion, and are unwilling to take a chemist's chance in a chemist's way. Therein lies, perhaps more than in any other one thing, the reason for Germany's supremacy in most of the branches of chemical industry. That also is the reason for the success of a great many of our own huge transportation, electrical and chemical enterprises. The business is run by men who know it from the technical point of view. Railroads are run by men who know the railroads from the operating and construction point of view; electrical enterprises by men who know the business from the electrical engineer's point of view, and they make their enterprises take their business chances in a transportation way, and in an electrical way. Practically all of our chemical enterprises that have been managed in the same manner have also been successful, but there is still great room for improvement, and just as soon as that improvement is accomplished, just so soon, and no sooner, will there be less and less talk about the incompetency of the American chemist. German chemical enterprises are run and managed by chemists.

Some years ago I was thrown in company with a very successful meat packer, and a very successful metallurgist; the packer asked me when chemists would make glycerin synthetically and make it cheap, as the price of glycerin was getting to be altogether too high; the metallurgist asked me, rather impatiently, what elements make up glycerin; somewhat dazed, I replied, "Carbon, hydrogen and oxygen." Thereupon the metallurgist said to the packer, "Why, carbon is coal, hydrogen and oxygen are water, both are plentiful and cheap; I do not see why these chemists can not mix coal and water and produce glycerin." I felt that my life was altogether too short to attempt to educate those two very successful men to a proper appreciation of the difficulties of converting coal and water into glycerin. This metallurgist's answer to the packer might with equal truth have referred to such dissimilar things as wood alcohol, grain alcohol, vinegar, olive oil, castor oil, whale oil, starch, camphor, cane sugar, beet sugar, grape sugar, carbolic acid, alizarin, and host upon host of similarly different things. I do not know whether that packer, when he got home, told his chemist to take a hunk of coal and drop it into a bucket of water, and make glycerin. I hope, for the chemist's sake, that he did not give him that task.

THE RESPONSIBILITY OF MANAGERS

If there is such a misconception of the chemistry underlying their own products

of manufacture on the part of many of our manufacturers, as this meat packer displayed, and if the general chemical viewpoint of the managers of many of our chemical industries is as confused and unfounded as was the view of this metallurgist, then it is no wonder that American chemical enterprises are behind some other countries; the real wonder is that we have any chemical industry at all. Nor is there any dearth in this country of properly trained chemists. There are almost ten thousand of them now in the United States, and they are being turned out by our technical and other schools with great regularity and with increasing volume every year. The fault is not with the American chemist, nor with his ability, nor his willingness; the fault lies principally and almost wholly with those in charge of many of our industrial enterprises, who fail absolutely in a chemical understanding of their own products and are devoid of any sympathetic contact with chemistry and with chemical points of view and therefore are incapable of, and unable to appreciate the value of chemical work or to have a wholesome understanding of the snares, the pit-falls and the tedium of chemical research.

CHEMISTS IN MANAGERIAL POSITIONS

This plea for the wider introduction of chemists in positions of managerial responsibility is, however, not to be interpreted into a statement that any kind of a chemist can do any kind of a chemical job. Just because a man can swing a scythe and cut wheat rapidly is no reason why he should be entrusted with the job of giving a man a shave; therefore, if you have a cotton oil problem, do not give it to a man whose specialty and training is in iron and steel only. The non-chemical managers of chemical enterprises will have their hands full picking out the right chemist for the right job and training promising chemical material for managerial positions. To do this successfully is quite an undertaking and will not be accomplished without many trials and many failures. Why should there not be failures? Not every man who is sent out on the road makes a successful traveling salesman, nor is every man put in as a superintendent a success as a superintendent.

In selecting your chemist for a responsible position, you must look out that you do not get a square peg for a round hole, just as you would when engaging a man for any other position, but the trouble seems to be with many of those who have engaged chemists, that they have not appreciated that there are chemists and chemists; they seem to have some sort of an idea that there is a magic about what a chemist does. Now, there is no magic at all. It is all plain, hard work, that calls for a lot of intellectual effort, and above all, the application of common sense, which, as every one knows, is a very rare article.

THE RESPONSIBILITY OF THE PUBLIC

With this record of solid achievement placed before you to-day, together with what I have just said, I hope that the conviction will finally break through, and will penetrate the public mind as well as the minds of those in charge of many of our industrial establishments, that if the American chemist is not doing as much as the public expect him to do, it is because the public through its industrial enterprises has deliberately declined to give him a chance. With this wonderful record of fruitful endeavor is the American chemist to have his chance? The answer to that question is largely in the hands of the American public.

However, the public will have to acquire in some dependable way an appreciation of what the chemists' work stands for and

really is. There are numerous difficulties in the way. By its very nature, the work of the chemist is more or less concealed from public inspection. If you have a particularly well tanned piece of leather, the layperson thinks no further than that it is a pretty good job, and is utterly unable to appreciate the large amount of work that has been necessary to produce or to create the way of making that particularly good piece of leather. There is nothing so conspicuous about the chemist's work as there is, for example, about the bridge builder's work, or about the work of a man who erects a skyscraper. The chemist's work, as a whole, does not fill the eye nor appeal to the imagination; and not filling the eye, and not appealing to the imagination there is really no practical method of valuation easily accessible to the ordinary individual; not only is the ordinary individual incapable of such a valuation, but even men high in industrial pursuits have not that particular intellectual vision which permits them to appreciate the real significance behind any given chemical product. The only exception hereto seems to be coal-tar dyes.

The reason for this exception is not hard to find. Could anything appeal more to the imagination than the conversion of such a disgusting, sickly mess as coal tar into brilliant colors that rival and excel every tint and shade in nature?

THE RESPONSIBILITY OF THE CHEMIST

However, the chemist must not attempt to absolve himself from all responsibility for the prevailing lack of appreciation or skepticism among capitalists and bankers of the value of chemical work in industrial operations. While competent chemists and chemical engineers by their very effective work have wrung from reluctant financial men proper acknowledgment of the value of chemical examination, control and management of enterprises requiring such, yet the work has not gone far enough, and it is not at all unusual for financial men to support with might and main enterprises which any qualified chemist or chemical engineer could and probably did tell them were foredoomed; also it must not be forgotten that qualified chemists and chemical engineers, like other professional advisers, have gone astray in their calculations and have supported enterprises which ultimately failed. The mining, electrical and railroad engineers finally succeeded in obtaining their present influential position among the industrial councils of this country and with the brilliant success of the chemical engineers of Germany in the same direction it is not too much to hope that ultimately the American chemist and chemical engineer will come into his own. When he does, there will be far fewer exploitations than heretofore of the wild and fantastic schemes of chemical enterprise now so easily financed by the gullible portion of our investing public and fewer and fewer failures of chemical enterprises undertaken in good faith and serious mood.

Therefore, let every chemist in advising on chemical operations prominently bear in mind that failure to give correct advice not only reacts upon him but upon each and every member of the chemical profession and merely helps to postpone the day when the chemist will come into his proper position among the makers of the nation.

CONCLUSION

To bring the matter up squarely before you let me recapitulate: The 10,000 chemists in the United States are engaged in pursuits which affect over 1,000,000 wage-earners, produce over $5,000,000,000 worth of manufactured products and add $1,725,000,000 of value by manufacture each year; the business in products of and for chem-

ical industry between the United States and Germany alone in 1913 provided 5 per cent. of our total foreign business and 13.8 per cent. of our balance of trade for that year. Please bear in mind that I am not by any means attempting to claim all the credit for this for the chemist; all that I ask is that his claims to recognition for intelligent, active and effective collaboration in bringing about those stupendous results be not thrown aside as worthless and that he shall not be made the target of unjust criticism because in 1914 there was a shortage of about $600,000 or 7 per cent. in coal-tar dyes and because cotton dropped from 15 cents to 6 cents.

Much more could be said of the chemist and his contribution to the effective every day labor of this work-a-day world but time and space forbid. I am sure that this short sketch of the chemist's activities, his hopes, his aims and his work will serve to create a wider interest in him and will result in according to him the credit to which he is entitled, namely, that he pulls more than his own weight in our nation's boat.

BERNHARD C. HESSE

THE GRAY HERBARIUM

THE rebuilding of the Gray Herbarium, which has been in progress for some years, has just been finished by the completion of the main central section of the building. The original structure, the gift of Nathaniel Thayer in 1864—at which date Dr. Asa Gray gave his invaluable botanical collections to Harvard University—was a brick building and for its time substantial, but the entire interior finish, including the floors, the plant cases, book shelving, etc., was of wood. The building had become wholly inadequate for the growing collections and was far from being fireproof in any modern sense.

The complete rebuilding and considerable enlargement was begun in 1909 and has been carried out a section at a time. It has been effected through the generosity of members of the visiting committee. The initial step consisted in the erection of a substantial ell, known as the Kidder wing, the gift of Mr. Nathaniel T. Kidder, of Harvard, '82. This wing, completed in 1910, provided convenient shelving space in exceptionally secure cases for more than 300,000 sheets of herbarium specimens as well as a portion of the library, thus giving great relief from the congestion of the older building.

In 1910 the adjacent residence, formerly occupied by Dr. Gray, was moved to the opposite side of Garden Street, and in its place was built in 1911 the Library wing of the herbarium. This portion of the building, furnishing ample quarters for the convenient shelving of the library, with extensive provision for its growth, was given anonymously and was completed in 1912. Last year, however, the donor, Dr. George Golding Kennedy of the Harvard class of '64, kindly consented that his name might be announced in connection with the fiftieth aniversary of the graduation of his class.

This wing contains, besides the library, the private offices of the curator, Professor B. L. Robinson, and the librarian, Miss Mary A. Day, a room for maps, files and publications, and, in the basement, a press-room for the drying and preparation of specimens, a photographic dark-room, a staff-room and store room.

At the same time, the old and wholly inadequate laboratory and auditorium, which had formed the opposite wing of the earlier structure and had been built in 1871 by the gift of Horatio Hollis Hunnewell, were taken down and replaced by the George Robert White Laboratories of Systematic Botany, a wing of much greater capacity, well arranged, well lighted and provided with complete and highly perfected equipment for its purposes. This wing, the gift of Mr. George Robert White, of Boston, contains on the ground floor two laboratories, one used by the Harvard students in systematic botany, the other by the Radcliffe students. On the second floor, there is an instrument room, a "bundle-room" for the safe storage of collections awaiting study,

labeling, distribution as duplicates, etc., also Professor M. L. Fernald's private office, and finally a large and fully furnished room, which has been placed at the service of the New England Botanical Club for its extensive and valuable herbarium.

In 1912, by a second gift from Dr. George G. Kennedy, it was possible to carry out another highly important step in the general plan of reconstruction by rebuilding of the front portion of the original structure, raising it from one and a half to three stories in height and furnishing accommodations for an exceptionally convenient mounting room, a coat-room, a private office, a room for the collection of "box material" (*i. e.*, fruits, nuts, cones, etc., which from form and thickness can not be readily affixed to the ordinary herbarium sheets), and a room for the Pterydophyta and Gramineae.

As these successive additions were made to the earlier building, the collections both of specimens and books had been so far as possible removed from the old central portion to the surrounding new and fireproof wings. Early in 1914 the last part of the old building, namely the main central room, a story and a half structure, with narrow wooden gallery, was taken down, to be replaced by a structure of greater height and much more substantial construction. This final portion of the building is now completed. It and its steel furnishings have been the gift of Mr. White, Dr. Kennedy, Mrs. William G. Weld, Miss Susan Minns and Mr. John E. Thayer. As rebuilt this main room is furnished with two steel and glass galleries, of convenient breadth, each provided like the ground floor with a series of steel herbarium cases. The room is further furnished with blocks of table-topped cases, rising to counter height; also with large steel tables, covered with battleship linoleum and of height convenient for microscopic work and plant-dissection. The room is provided with copious north light, as well as overhead light. The well lighted basement of this section of the building has been furnished as a sorting room and to that end has been provided with thirty tables which together furnish room for more than two hundred piles of herbarium sheets and thus permit even the more complicated kinds of sorting without crowding or overlapping. These basement tables are made of "transite," a neat light gray stone-like material made of Portland cement and asbestos fiber.

Although the reconstruction has thus proceeded by sections, the building has lost nothing in unity, for the whole was carefully planned at the outset and each successive portion was built with due regard to its relation to the whole structure. In the whole process of building and furnishing there has been a strenuous effort to eliminate woodwork and all combustible materials. The building itself is of brick with floors and roof of reinforced concrete. All doors, jambs, sash and window frames are bronze, copper or steel-sheathed. There is no exposed woodwork in any part of the building, inside or out. As to the furnishing there has been the same attention to safety. All the plant cases, work tables, desks, bookshelving, files, wall cabinets, etc., built to order by the Art Metal Construction Company, of Jamestown, New York, are of steel, for the most part enameled in agreeable shades of gray-green or deep green with bright or oxidized brass trimmings. Even the waste-baskets are of metal. At some points in the furnishing it has seemed best and entirely safe to make certain concessions to comfort and sentiment. Thus the chairs are still of wood, the window-shades are still of linen (though they are on metal rollers), and in the curator's office some articles of wooden furniture formerly belonging to Dr. Gray are kept in consequence of association and sentiment. Furthermore, no substitute for wooden picture frames has been found, at least none which has proved esthetically agreeable. With these trifling exceptions, however, all combustible materials have been scrupulously avoided.

The herbarium itself, *i. e.*, the great collection of dried plants mounted on sheets of cardboard, would of course prove highly inflammable, but it is preserved in cases which form, as one may say, so many fire-tight compartments, so that even were a fire by some accident started it could not possibly spread.

Although the primary ideals followed in the rebuilding of the Gray Herbarium have been those of safety, permanence and convenience of arrangement, the resulting structure though architecturally plain is by no means homely. Indeed, its good proportions, dignified simplicity and obvious solidity give it a pleasing effect. It is a building to which the architect, Mr. W. L. Mowell, of Boston, has given a good balance, but it has purposely been kept from absolute symmetry from a feeling that such initial symmetry, if attempted, would render it much more difficult to make future additions, as these prove needful with the growth of the collections.

It is a notable fact that during the complete rebuilding of the establishment, the Gray Herbarium and its library have been open as usual for consultation. Though several reshelvings and transfers of materials from one section to another have of course been needful and demanded the care and attention of the staff from time to time, nevertheless the scientific work of the staff, students and visiting specialists has proceeded with surprisingly little interruption. The building has been continuously occupied and when it is borne in mind that much of the new structure has been built upon the old foundations, it will be seen by the many botanists for whom the earlier building had many pleasant sentiments and associations, that it is perpetuated rather than replaced by the new one.

ELISHA WILSON MORSE

ELISHA WILSON MORSE, formerly instructor in natural history at the Bussey Institution of Harvard University and well known for his contributions to the history of domesticated animals, died in Washington, D. C., on April 18, from pneumonia.

During the past few years Mr. Morse served as a specialist in animal husbandry in the U. S. Department of Agriculture. Aside from his official duties as an associate editor of the *Experiment Station Record* and later as a scientist in the U. S. Dairy Division, he was especially active in putting the foundations of animal breeding and feeding on firmer bases. He was one of the few who had a keen appreciation of the value of applying sound biological and statistical principles to the interpretation of feeding trials.

Mr. Morse was a graduate of the class of 1897 of Harvard University, an active member of the Biological Society of Washington, the American Society of Animal Nutrition, and the Boston Society of Natural History, and a regular contributor to several standard year books and encyclopedias.

LEWIS WILLIAM FETZER

SCIENTIFIC NOTES AND NEWS

THE presidency of the German Association of Scientific Men and Physicians, vacant by the death of Professor Eberhard Fraas, has been filled by the vice-president, Dr. F. von Müller, professor of internal medicine at Munich.

THE annual address before Sigma Xi and Phi Beta Kappa of the University of Illinois, which in previous years has been given during commencement week, will be given this year on May 4, by Dr. George Otis Smith, director of the U. S. Geological Survey. The subject is "Practical Ideals."

DR. JULIUS HIRSCHWALD, professor of geology and mineralogy in the Technical School at Berlin, has been given the doctorate of engineering by the Technical School of Dantzig, on the occasion of his seventieth birthday.

AT the meeting of the Entomological Society of France, on January 27, the committee appointed to nominate an honorary member in place of the late M. J. Perez reported that, while custom decreed the election of a Frenchman to fill this vacancy, it appeared to the committee as very proper, under existing conditions, to break away for once from the traditions and custom of the society and to give this honor to M. A. Lameere, professor in the University of Brussels, as an especial testimony of the sympathy and esteem of the society for one of the most eminent representatives of Belgian entomology.

DEAN EDWARD ORTON, JR., of the College of Engineering of the Ohio State University, has

been granted leave of absence for next year, but expects to remain at Columbus. Professor Edwin F. Coddington, of the department of mechanics, now secretary of the college, will be acting dean next year. Professor Charles C. Morris, of the department of mathematics, will fill the new position of assistant to the dean.

Dr. Edmond W. Wilson has been promoted to the position of assistant superintendent of the Boston City Hospital, filling the vacancy caused by the resignation of Dr. Frank H. Holt, who has assumed his new duties as superintendent of the Michael Reese Hospital, of Chicago.

Dr. Roy K. Flannagan, of Richmond, has been appointed assistant commissioner of health of Virginia, succeeding Dr. Allen W. Freeman, who resigned to accept the position of epidemiologist in the United States Public Health Service.

Dr. Philip J. Castleman has been appointed director of the bacteriological laboratory of the Boston Board of Health to succeed Dr. James J. Scanlon, who died a short time ago.

Dr. Albion W. Hewlett, professor of medicine at the University of Michigan, has been appointed visiting lecturer on medicine at the Harvard Medical School, and is to serve as visiting physician at the Peter Bent Brigham Hospital.

Mr. William Harper Davis, of Philadelphia, at one time assistant in psychology at Columbia and instructor and professor in philosophy and psychology at Lehigh University, secretary of the American Psychological Association, etc., who has latterly been engaged in business, has accepted the position of librarian to the Public Service Corporation of New Jersey. His address after September 1 will be the company's office, Newark, N. J.

Sir Rupert Clarke, who in the summer of last year led an expedition up the Fly River in British New Guinea, has returned to London.

Dr. David L. Edsall, professor of clinical medicine at Harvard Medical School, delivered the annual address of the Pathological Society of Philadelphia on April 22, his subject being "Bearings of Industry upon Medicine."

Since Easter, Professor George Grant MacCurdy, of Yale University, has lectured on "The Dawn of Art" for the Archeological Institute of America at Richmond, Va., Washington, D. C., and Rochester, Auburn, Syracuse and New York, N. Y.

Major Samuel Flood-Page, who was active in development of electric lighting and wireless telegraphy, died on April 7, aged eighty-one years.

Professor Karl Theodor von Heigel, president of the Bavarian Academy of Sciences, has died at the age of seventy-three years.

There have been killed in the war Dr. Fr. Ostendorf, professor of agriculture in the Technical School at Karlsruhe; Dr. Hans Hammerl, associate professor of hygiene at Gratz, and Dr. August Wolkenhauer, docent for geography at Göttingen.

The Serbian typhus epidemic may be controlled if the proper equipment is made available, according to a cablegram received on April 29 from Dr. Richard P. Strong, head of an American commission recently sent to Serbia by the American Red Cross, assisted by the Rockefeller Foundation and the Serbian relief committee. Messages received at the headquarters of the American Red Cross announce that an international board of health has been formed at Nish. The president of the international board is Prince Alexander of Serbia, the vice-president, Sir Ralph Paget of England. Dr. Strong was made medical director of the board, and the members include the heads of the French, Russian and English sanitary commissions. Dr. Strong, who is professor of tropical diseases in Harvard Medical School, appeals for more doctors and sanitary and medical equipment and declares that if Dr. William C. Gorgas, surgeon-general of the United States Army, will accept a commission in combating the typhus in Serbia, the international board just formed will make him medical director and Dr. Strong will serve as his assistant. The remainder of the American commission, which numbered ten sanitarians

and bacteriologists, have reached Salonica, Greece, and will join Dr. Strong at Nish shortly.

A MAJORITY of the members of the board of regents of the University of Minnesota, sitting as the executive committee of the board, has voted unanimously to adopt the following statement of purpose:

> Although the board of regents has not as yet officially considered a proposed affiliation with the Mayo foundation, in order to make clear the policy of the board, be it voted:
>
> "First, that in any event the regents do not enter into any permanent arrangement within four years;
>
> "Second, that the board enter into no permanent affiliation which does not give the regents complete control, within the specific purposes of the foundation, of the endowment funds administration, and teaching."

By a vote of 36 to 31 the state senate has passed a bill as follows: The board of regents of the University of Minnesota shall not affiliate or unite with any persons, firm or corporation under any agreement, arrangement or understanding which will preclude the board from exercise of any of its functions in the educational management and control of the university or any of its colleges, schools or departments. But this act shall not be so construed as to disable the said board from employing or authorizing the employment of instructors, lecturers or teachers who shall devote a part only of their time or service to the educational work of any department of the university.

A CONFERENCE of the Massachusetts Association of Boards of Health and the State Department of Health and voluntary organizations interesting themselves in matters of public hygiene was held in Boston on April 29. The speakers at the forenoon conference were Governor Walsh, Commissioner Allan J. McLaughlin, Dr. Charles W. Eliot, Professor Irving Fisher, Miss Ella P. Crandall, executive secretary of the national organization of Public Health Nursing, and Professor William T. Sedgwick, president of the American Public Health Association. This was followed by a business session over which Professor M. J. Rosenau, of Harvard University, presided. The speakers of the afternoon, and their subjects, were: "The Control of Communicable Diseases," Dr. Eugene R. Kelley, State Department of Health; "The Relationship Between the State and Local Boards of Health," Dr. Lyman A. Jones, district health officer, Berkshire district; "The Health of the Farmer," Dr. John S. Hitchcock, district health officer, Connecticut Valley District; "The Vacation Health Problem," Dr. Adam S. MacKnight, district health officer, southeastern district; "The Continuing Problem of Vaccination," Dr. Samuel H. Durgin, former chairman of the Boston Board of Health; "The Control of Cancer," Dr. Edward Reynolds, vice-president American Society for the Control of Cancer; "Some Problems of the Health Officer of a Small City," Dr. Francis G. Curtis, health officer, Newton; "Infant Mortality from the Standpoint of the State," Dr. William Hall Coon, district health officer, northeastern district.

THE Entomological Society of France, in January, took a ballot by mail among its active membership on the question of expelling all German members. The result of the ballot, just announced, was as follows:

Total number of ballots cast	270
For the immediate expulsion of all German members	126
For their expulsion after investigation	103
Statu quo until end of hostilities	37
Provisional expulsion	1
Blank ballots	3

Inasmuch as there was no majority in the whole number of ballots cast in favor of immediate expulsion *en bloc,* the question was referred back to the council to consider the spirit and the letter of the vote and the conditions under which the German members should be expelled.

THE United States Geological Survey opened on May 1 a district office at Boston, Mass., from which investigations of the water resources of the New England states will be carried on. For several years the Geological Survey has made measurements of the flow of streams in New England, the work being carried on from the district office at Albany, N. Y. The establishment of a district office at

Boston will make possible the extension of the work and will greatly facilitate the investigations. The states of Massachusetts, Maine and Vermont are cooperating in these investigations, and a bill is pending before the legislature of New Hampshire providing for cooperation in that state. Charles H. Pierce, district engineer of the Geological Survey, will be placed in local charge of the work.

The committee on arrangements give notice of change in date in the Interstate Cereal Conference in California previously announced in Science and also a change in one of the localities from Merced to Stockton as follows: The first day's meeting will be held at Stockton, Tuesday, June 1, for inspection of San Joaquin Valley cereals, while the following three days will be spent as previously stated, namely, the second day, June 2, at Berkeley, beginning the program of the conference; June 3 at Davis, finishing the program and inspecting the university farm, and the last day, June 4, at Chico, where the program, if still unfinished, can be concluded. At this place also an inspection will be made of the Plant Introduction Garden and the cereal experiment plats of the U. S. Department of Agriculture. During the day, those who desire to do so can also go the short distance to Biggs to inspect the rice experiment farm at that place.

Since the time of Captain Cook the Hawaiian Islands have been visited by geologists and others interested in the problems of volcanoes, and much has been written concerning them. Recently the United States Geological Survey has taken up the investigation of the islands from various economic and scientific points of view and is preparing topographic maps, which are necessary for many kinds of work. It has been found that the geologic history of the islands is by no means so simple as was supposed from the earlier publications concerning them. In Professional Paper 88, "Lavas of Hawaii and their Relations," by Whitman Cross, which has just been issued, the survey is presenting a summary of what is now known concerning the lavas of all the islands. This paper is largely technical in its character, for it is intended primarily to serve as a basis for future study of the rocks by geologists, but for any one interested in the various islands and not following strictly the tourist route there is considerable general information, not to be found elsewhere. The work is a summary of earlier publications supplemented by the author's own observations on the four largest islands—Hawaii, Maui, Oahu and Kauai. It appears that there are many other kinds of lavas in Hawaii besides basalt, and many facts of association of the different lavas are of interest to students of the inner history of volcanoes. While much is yet to be learned concerning the lavas of these islands, Mr. Cross shows that present knowledge of the rocks is sufficient to throw light on some of the most vexed questions pertaining to the origin and relations of the igneous rocks of the earth. The chemical relations are discussed with particular thoroughness. Petrologists will find valuable material in this report, bearing on many problems.

The shortage of potash salts in the United States in 1914 was further accentuated by the German embargo on export at the end of January, 1915. In spite of the interruptions to the normal trade in potash salts, the imports of salts proper in 1914 amounted to 485,818,459 pounds, valued at $8,743,973, according to a statement by W. C. Phalen, just made public by the United States Geological Survey. These figures represent a decrease in quantity and value amounting to 21 per cent. and 19 per cent., respectively, compared with 1913. These figures, however, do not represent the total imports of potash salts. There should be added the quantity and value of kainite and manure salts imported, amounting in 1914 to 482,876 tons, valued at $3,397,590, making a total importation during the year valued at $12,141,563, compared with $15,241,152 in 1913—a decrease amounting to $3,099,589 or approximately 20 per cent. Potash salts constitute only one of several fertilizers imported. Bone dust, calcium cyanamid or lime nitrogen, guano, basic slag and other materials used for manure are also brought in. The total quantity of these materials including kainite and manure salts imported in 1914 was 761,896 long tons, valued at $9,921,439. In addition to the above importations, sodium nitrate

valued at $15,204,539 came into this country from foreign lands, thus bringing the total value of imports as designated above up to $33,869,951.

UNIVERSITY AND EDUCATIONAL NEWS

MR. ANDREW CARNEGIE'S gifts to the Carnegie Institute and Institute of Technology have now reached a total of $27,000,000, his latest contribution announced at Founder's Day, on April 29, being $2,700,000. Of this latter amount $1,200,000 is for new buildings and $1,500,000 for endowment. The address at the Founder's Day exercises was delivered by Dr. Romulo S. Naon, the Argentine ambassador, who spoke on "The Triumph of True Pan-Americanism and Its Relation to World Peace."

THE campaign to raise $1,385,000 for the Stevens Institute of Technology in Hoboken, N. J., has been successfully concluded. The entire indebtedness of the college, amounting to $385,000 has been cancelled, leaving $1,000,000 to be used for the erection of new buildings and for endowment.

THE University of Pennsylvania, Columbia University and the Stevens School of Technology mechanical engineering departments have received funds amounting to $5,000 each, in accordance with the provisions of the will of the late Admiral George W. Melville.

GIFTS amounting to $72,908, to be devoted to cancer research at the Harvard Medical School, have been announced. Of this sum $50,000 is provided by the will of Philip C. Lockwood, of Boston.

THE new buildings of the medical school of Washington University, St. Louis, were dedicated on April 29. The three large buildings, which contain laboratories, dispensaries, lecture rooms and libraries, cost $1,200,000 and, with the new Barnes Hospital, the St. Louis Children's Hospital and St. John's Hospital, form an important group of buildings devoted to medical and surgical purposes. Addresses were delivered by Dr. William Henry Welch, professor of pathology at Johns Hopkins University; by President A. L. Lowell, of Harvard University; by Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching, and by President George E. Vincent, of the University of Minnesota.

THE University of South Dakota has completed the erection of a fireproof chemical laboratory at a cost of $100,000.

THE thirty-fourth session of the legislature of Nebraska recently adjourned appropriated the sum of $150,000 for the erection of a teaching hospital on the campus of the University of Nebraska College of Medicine at Omaha, Nebraska. The appropriation has been approved by the governor.

THE tuition fee at Harvard University has been increased to $200, which will take effect at the beginning of the year 1916–17, but will not apply to a student now registered, unless he changes his department. No infirmary, laboratory or graduation fees will be charged.

PROFESSOR IRA C. BAKER has resigned his position as head of the civil engineering department of the University of Illinois, which he has held for thirty-four years. He will continue to give a limited number of courses. Dr. F. H. Newell, consulting engineer of the U. S. Reclamation Service, has been appointed to succeed Professor Baker as head of the department of civil engineering. He entered upon his work at the university on May 1.

DR. ANDREW HUNTER, of the medical department of Cornell University, has accepted an appointment to the chair of pathological chemistry in the University of Toronto.

DR. A. A. KNOWLTON, associate professor of physics at the University of Utah, has been elected professor of physics at Reed College. It will be remembered that Dr. Knowlton was not reelected at the University of Utah because of the president's charge that he had made remarks unfavorable to the administration of the university. President Foster of Reed College went to Salt Lake City to investigate the situation. He talked with both factions of the board of regents, with many members of the faculty, including those who have resigned and those who have not, with other citizens, with students and with the president.

As a result of this investigation at first hand, Dr. Foster was convinced that Dr. Knowlton and the other men of the faculty at Salt Lake City have assumed no greater freedom of speech than every member of the Reed College faculty has as a matter of course.

DISCUSSION AND CORRESPONDENCE

ON THE PRODUCTION OF RARE GASES IN VACUUM TUBES

To the Editor of Science: A number of investigators, among them Sir J. J. Thomson, Sir W. Ramsay, Winchester, and Collie, have found that helium and neon are produced in vacuum tubes by electrical discharges. These gases were not accompanied by argon, and therefore not due to leaks in the apparatus.[1] A thoroughly satisfactory explanation of the appearance of the gases remains to be given, although a very plausible hypothesis has been advanced by Professor Winchester. Winchester[2] finds that helium and neon are given off from aluminium electrodes only during the first few hours of long-continued discharges, and he therefore concludes that the gases must have been occluded on the surfaces from the atmosphere.

This explanation agrees with a number of facts. For example, we may explain a *second* liberation of helium and neon, sometimes noticed in vacuum tubes after many hours' continuous running, by supposing that a surface layer (*e. g.*, slag), imbedded in the metal when it was poured, becomes exposed when the electrode is partly "spluttered" away. The non-appearance of these gases when very heavy discharges (*i. e.*, large currents) are used, as in one experiment with uranium, by Collie,[3] would mean that the surface layer is spluttered away before any considerable amount of gas has been liberated.

There is an alternative explanation which fits the facts equally well, if we admit the possibility of changes of a radioactive nature taking place in an ordinary vacuum tube. But there is, in the first place, no good evidence that ordinary inactive matter can be transformed by the radiations of radioactive substances;[4] and consequently, in view of the great energy of the α particles, there is reason for supposing that the swiftest ions in a vacuum tube are equally incapable of producing disintegration of atoms (or rather, according to recent views, disintegration of nuclei; the resultant positive charge upon which determines the chemical properties of atoms[5])—unless, perhaps, there were present in the tube enormous differences of potential. Nevertheless, in an experiment by Sir W. Ramsay,[6] evidence is given which suggests an inter-relationship between the elements helium, neon and oxygen.

Certain experiments performed by the writer upon the conduction of electricity at contacts of dissimilar solids[7] show that, however carefully a metal may be cleaned in air, or in pure electrolytic oxygen, a surface film remains, sufficient to give electrical properties to such a surface, markedly different from those obtaining upon a surface that is cleaned mechanically in vacuo, or in pure electrolytic hydrogen. This being the case, it is seen that all electrodes hitherto employed in the production of rare gases have had a layer of oxide on the surface—traces of which must have remained until all the original surface had been removed by the action of the discharge.

In view of this fact it seems desirable that a tube be constructed, with electrodes similar to those used by Winchester[8] (which were found to liberate the gases rapidly); it being possible to clean these electrodes on all sides,

[1] T. R. Merton, Roy. Soc., *Proc.*, Ser. A, 90, pp. 549–53, August 1, 1914.

[2] G. Winchester, *Phys. Rev.*, N. S., Vol. 3, pp. 287–94, April, 1914.

[3] J. N. Collie, Roy. Soc., *Proc.*, Ser. A, 90, pp. 554–56, August 1, 1914.

[4] Rutherford, "Radioactive Substances and their Radiations," 1913, § 116.

[5] Rutherford, *Phil. Mag.*, Vol. 27, 6 ser., pp. 488–98, March, 1914.

[6] Sir W. Ramsay, Collie, and Patterson, *Nature*, Vol. 90, p. 653, February 13, 1913.

[7] R. H. Goddard, *Phys. Rev.*, Vol. 28, No. 6, pp. 405–28, June, 1909.

[8] Winchester, *loc. cit.*

mechanically, in vacuo; the apparatus, moreover, occupying but a small volume. The writer ventures to suggest the apparatus described below as being one which embodies the above essentials; the electrodes being substantially the same as those used by Winchester, which were in the form of circular loops of 2 mm. wire, 7 cm. in circumference, and 1 mm. apart.

Referring to Fig. 1, the electrodes are two straight parallel aluminium rods R_1, R_2, 2 or 3 mm. in diameter, and 8 cm. long. They are fastened to the glass tube T_1 by being bent around the ends of this tube, shown clearly in the horizontal section, Fig. 2.

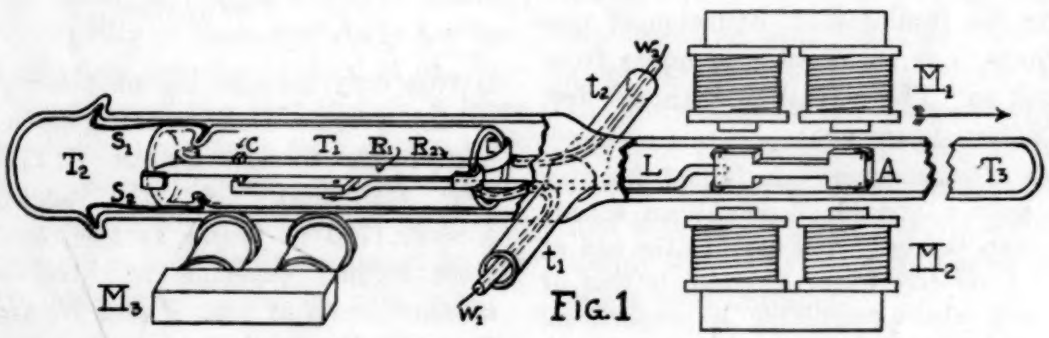

FIG. 1

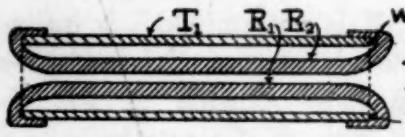

FIG. 2

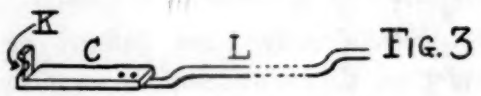

FIG. 3

This tube, T_1, is held in a larger tube, T_2, by springs S_1 and S_2 (wires), the ends of which fit into dents in the glass tubes T_1 and T_2. Leading-in wires w_1 and w_2, attached to the ends of R_1 and R_2, respectively, are sealed into the two side tubes t_1 and t_2, Fig. 1; said side tubes connecting with a pump and a spectroscopic tube of the usual type.

A cutter, C, of hardened steel is attached by a flexible brass rod, L, to an armature, A. The cutting edge, K, Fig. 3, is semi-circular, to fit the rods R_1 and R_2. The armature A has small brass rollers at the corners, to prevent scratching the inside of T_3, and can be moved back and forth within this tube by means of electromagnets, M_1 and M_2.

While the armature, A, is being moved in the tube, the cutter, C, is pressed against R_1 and R_2 in turn by means of another strong electromagnet, M_3—the cutting stroke being in the direction of the arrow. This operation scrapes but one side of each rod, R_1, R_2. To scrape the other two sides, A must be turned through 180°, which is accomplished by turning M_1, M_2 through this angle. After the rods have been cleaned, A, L, C is moved into the tube T_3, out of the way. It will be noticed that the apparatus is, essentially, a "spoke shave" in vacuo.

By using the above tube after the electrodes have been cleaned in pure (electrolytic) oxygen, it should be possible to demonstrate conclusively the transference of oxygen into helium and neon, if such indeed exist. On the other hand, if (as seems more likely) the helium and neon which appear in vacuum tubes have previously been occluded by the metal from the atmosphere, it should be possible, by means of the apparatus, to study the rates of, and the conditions governing, such absorption.

It is by no means certain, however, that the action in question consists simply in the liberation of absorbed gases, for Sir J. J. Thomson[9] has discovered evidence of a genuine production of helium and X_3 from elements (lead) and chemical compounds (salts of sodium and potassium) which suggests an actual atomic change, if not a genuine disintegration. The

[9] Sir J. J. Thomson, Roy. Soc., *Proc.*, Ser. A, 89, pp. 1–20, August 1, 1913.

whole problem is very complicated, and it is the writer's purpose merely to call attention to the importance of surface conditions in the production of the rare gases.

Robert H. Goddard
Clark College

The Fundamental Equation of Mechanics

Mr. Kent, in his recent communication, invites expressions of opinion from Professor Huntington and myself regarding his method of explaining the principles of dynamics. My own view is that Mr. Kent's explanation of the effect of a constant force in giving motion to a free body initially at rest is entirely sound. It is, in fact, substantially the explanation I have long used in the classroom as a first step in establishing the fundamental equation of motion. Perhaps it is permissible to quote from my text-book on "Theoretical Mechanics," first published fifteen years ago:

> If a force of constant magnitude and direction acts, for a certain interval of time, upon a body initially at rest, the body will have at the end of the interval a velocity whose direction is that of the force, and whose magnitude is proportional directly to the force and to the duration of the interval, and inversely to the mass of the body.

Since mass has already been defined as quantity of matter, this statement is seen to be identical in meaning with Mr. Kent's statement that "the velocity varies directly as the time and as the force, and inversely as the quantity of matter."

Mr. Kent's equation $V = KFT/W$ is entirely satisfactory and sufficient so long as our study is confined to the case in which a force whose direction and magnitude remain constant acts upon a body otherwise free and initially at rest. This is, however, a very exceptional case. The fundamental principle in its generality can be expressed only by introducing the notion of *instantaneous rate of change of velocity, i. e.,* acceleration. When this is done Mr. Kent's statement quoted above must be replaced by the statement that "the acceleration varies directly as the force and inversely as the quantity of matter," while his equation $V = KFT/W$ is superseded by the more general one $a = KF/W$. This is identical with equation (5) of my former communication,[1] except that quantity of matter is there represented by m instead of W.

To pass from the equation

$$\text{acceleration} = K \times \frac{\text{quantity of matter}}{\text{force}} \qquad (1)$$

to the equation

$$\text{acceleration} = \frac{\text{quantity of matter}}{\text{force}} \qquad (2)$$

of course requires that units should be defined so that unit force acting on unit quantity of matter causes unit acceleration. Mr. Kent regards this as an objection to equation (2). If the objection is valid a similar one seems to apply to his own procedure. His equation

$$V = 32.1740 \frac{FT}{W}$$

is true only because his unit force is defined as the force which would give a pound of matter an acceleration of 32.1740 ft./sec.^{2} The statement that the accurate value $K = 32.1740$ is found as the result of "the most refined experiments, involving precise measurements of both F and W, and of S, the distance traversed during the time T, from which V is determined" is quite misleading. The stated value of K is not based upon any refined measurements of the character described, but upon a purely ideal definition of the unit force; just as the value $K = 1$ results from a different ideal definition.

If there is any reason for preferring the set of units which makes $K = 32.1740$ to that which makes $K = 1$ in equation (1), it is not because the former is any more easily understood than the latter. "The force which, acting upon a pound of matter, would cause an acceleration of 32.1740 ft./sec.^{2}" is the same kind of a definition as "the force which, acting upon a pound of matter, would cause an acceleration of 1 ft./sec.^{2}" It is true that the former of the two units of force thus defined

[1] Science, April 23, 1915, p. 609. It is well known that Mr. Kent objects to the use of the word mass for quantity of matter; my present object is to make my meaning clear rather than to invite an unprofitable discussion over a purely verbal question.

has nearly the value of that used in the "ordinary English system," and this may be regarded as an advantage.[2] The unit in "ordinary" use, however, is not and never will be the exact "standard" pound, because for almost all practical purposes the refinement of distinguishing between "local" and "standard" gravity-pull is of no importance. For precise work there appears to be absolutely no choice between the system which makes $K=32.1740$ and that which makes $K=1$ except that the latter simplifies the fundamental equation and all equations depending upon it.

Mr. Kent thinks the C.G.S. system "should not be inflicted on young students" because it is "only used in higher physical theory." The great majority of those who study mechanics are preparing for the profession of engineering. In view of the fact that in a large and increasingly important part of the present-day field of engineering—applied electricity—the units employed are based upon the C.G.S. system, it is difficult to assent to the view expressed by Mr. Kent on this point.

L. M. HOSKINS

STANFORD UNIVERSITY,
March 29, 1915

[2] The same advantage may be retained with the simpler equation (2) if we permit quantity of matter to be expressed in terms of a unit other than the pound. Why the reduction of quantity of matter from pounds to units 32.1740 times as great as the pound should be regarded as more puzzling than the reduction from pounds to tons or the reduction of a length from inches to feet, is something I have never been able to comprehend.

CONDITIONS AT THE UNIVERSITY OF UTAH

TO THE EDITOR OF SCIENCE: In view of the fact that seventeen members of the faculty of the University of Utah have resigned their positions on the ground that it seemed to them "impossible to retain their self-respect and remain in the university," the council of the American Association of University Professors has authorized the appointment of a committee of inquiry to report upon the case. At the request of the president, the secretary of the association recently spent four days in Salt Lake City investigating the situation in the university and collecting evidence to be laid before the committee. The special purposes and scope of the investigation are indicated in the extract from the letter addressed by the secretary of the association to the president of the university, which was printed in the issue of SCIENCE for last week.

The report of the committee of inquiry will be prepared and published at as early a date as is practicable. It is the purpose of the committee to present all the pertinent facts so fully in its report that university teachers may judge for themselves as to the administrative methods, and the conditions of professorial service, in the university. We make this statement in order that any one who is considering either the acceptance of a position in the university or the recommending of others for such a position, may look forward to a full knowledge of the situation in the near future, and may postpone immediate action in case he deems such knowledge advisable before reaching a final decision.

JOHN DEWEY,
President of the American Association of University Professors,
A. O. LOVEJOY,
Secretary of the American Association of University Professors,
EDWIN R. A. SELIGMAN,
Chairman of the Committee of Inquiry

April 30, 1915

UNNATURAL HISTORY

TO THE EDITOR OF SCIENCE: I am sure your readers will be interested and instructed, and the monotony of their daily grind relieved, by the following information regarding hitherto unsuspected details in the life history of the kangaroo. These facts were given out by a university student in response to the question: "Explain how the young kangaroo obtains its nourishment."

"Immediately after birth they are swallowed by the mother and finally lodged directly over the breasts, the teats being directed inwards.

Here in their mother's heart the young marsupials are nourished for some time, when they are expelled from the mother fully developed and ready to begin life."

C. C. Nutting

SCIENTIFIC BOOKS

Infection and Resistance. By Professor Hans Zinsser, Professor of Bacteriology at the College of Physicians and Surgeons, Columbia University, New York City. The Macmillan Company. 1914. Pp. 546. Illustrated. $3.50.

This work is conspicuously the most thorough and modern original treatment of the subject of infection and immunity that we have in the English language. The author's own work in the field of immunology, citations to which are frequently made in the text, makes the book authoritative.

We find in the book an exhaustive and impartial analysis of the enormous accumulation of recent work in this field with a wealth of references to original sources given at the bottom of the pages. The survey of the subject is complete, and yet each chapter is a unit in itself, making the book a convenient reference in which to gain a knowledge of any one phase of immunity. This unit arrangement of the chapters has necessitated some repetition, but not to an extent to become boresome.

The text is not intended to be elementary or summary and can not be recommended for the average reader or undergraduate student. It can be most cordially recommended to practitioners, teachers, laboratory workers and especially as a text for medical students for whom it is primarily intended.

Starting with the general problem of Virulence, the author discusses successively the Bacterial Poisons, Natural and Acquired Immunity, Antitoxins, Cytolysis, Complement and Diagnosis, Agglutination, Precipitation, Phagocytosis (four chapters), Anaphylaxis (three chapters), Therapeutic Immunization, and a chapter on Abderhalden's Work on Protective Ferments. Dr. Stewart W. Young has been invited to write a concluding chapter on Colloids, which gives a comprehensive idea of the nature of this state of matter, and the relation of colloids to biological problems.

The chapter on Therapeutic Immunization in Man might be criticized on account of its brevity in contrast to the rest of the book. It seems to the reviewer as though it could be made more effective even in the space allotted by the introduction of more data to show the efficacy of our marvelous advances in immunology.

C. M. Hilliard

The Differentiation and Specificity of Starches in relation to Genera, Species, etc. Stereochemistry applied to Protoplasmic Processes and Products, and as a Strictly Scientific Basis for the Classification of Plants and Animals. By Edward Tyson Reichert, M.D., Professor of Physiology in the University of Pennsylvania, Research Associate of the Carnegie Institution of Washington. In two parts. Published by the Carnegie Institution of Washington, Washington, D. C. 1913. Pp. 900, plates 102.

The author intends that the present memoir on starches shall have a relation to the memoir on hemoglobins worked out by Reichert and Brown and reviewed in Science (January 27, 1911). If there is a relationship between these two memoirs it is rather in what Dr. Reichert has attempted to perform than in what he has succeeded in accomplishing. The two memoirs are so different that a comparison of them is well-nigh impossible. In the one, we almost see the master and in the other the novice. The memoir on hemoglobins represents a painstaking research and is an important contribution to biology. The memoir on starches, in its present form, is hardly worthy to be classed as research, particularly in view of the splendid monograph of Naegeli which has been reputed to be among the greatest investigations of the last century. In the work on hemoglobins, through the cooperation of Dr. Brown, the exact methods of physical crystallography have been employed and it is to be expected that in the hands of different investigators confirmatory results will be obtained in the examination of the crystals of the various hemoglobins. In the present memoir on

starches, Dr. Reichert has replaced exact quantitative methods by those which under certain conditions might have a confirmatory value, but certainly are of no specific importance, as will be shown later, so that independent investigators may be able to confirm his observations and distinguish one species or genera from another. It is only necessary to read carefully a work like that of Solereder on the "Systematic Anatomy of the Dicotyledons" to appreciate the nature of the task that confronts an investigator who attempts to solve a fundamental problem such as Dr. Reichert has attempted.

Before critically examining the work it may be desirable to mention the contents of these two large volumes. Nearly 300 pages are devoted to a résumé of the important monographs and some of the important papers on the starches. The best part of this portion of the work is the translation from Naegeli's monograph on "Die Stärkekörner," giving his classification of some 1,200 starches. This comprises nearly 100 pages. Any review of the literature on starch must be unsatisfactory, as it is likely to be inadequate, and this is especially true of the summary by Dr. Reichert. It would have been far better in a memoir like this had Dr. Reichert placed in chronological order the literature which he cited so that it might be consulted or referred to by the student and the investigator, particularly if he intended this to be a work of reference on starches.

In Chapter VI. we find a discussion of some of the methods that the author considers might be employed in an investigation of this character and which involved the study of over 300 starches, which he isolated from as many different plants. He employed essentially six different methods: (1) Histological method, involving the study of the form, markings and size of grains. (2) Polariscopic properties, *i. e.*, reactions using polarized light both with and without selenite. (3) Iodine reaction, using 0.125 per cent. and 0.25 per cent. of Lugol's solution. (4) Action with aniline dyes, using gentian violet and safranin, using 5 c.c. of a solution containing 0.05 per cent. of aniline dye. (5) Temperature of gelatinization, which was determined with a specially constructed water bath, and in which was placed test tubes containing a small quantity of starch with 10 c.c. of water. (6) Several swelling reagents were used, viz., chloral-hydrate-iodine solution, chromic acid in the form of a 25-per-cent. solution; ferric-chloride solution consisting of equal parts of a saturated solution in water, and Purdy's solution, which was made up of equal parts of the standard solution and water.

In the preparation of the starches, the material was comminuted, mixed with water, strained through cheese cloth, centrifugalized and washed with water and re-centrifugalized to remove as much impurity as possible.

The various starches were photographed both with and without polarized light. Some of these photographs are very excellent and in some instances may be of some scientific value. For the most part, however, unless photographs of starches are supplemented with drawings they lose much of their interest and significance.

Great stress is laid by the author on the different reaction intensities of the several reagents on any given starch and these have been set forth graphically in the form of curves with a view of affording a clear presentation of the quantitative reaction peculiarities of the starches and permit of comparison between them. "In the construction of the charts the abscissas have been used to express the degree of polarization (*P*), the intensity of the iodine reaction (*I*), the intensity of the gentian violet reaction (*GV*), the intensity of the safranin reaction (*S*), the temperature of gelatinization (*T*), the time-reaction of chloral hydrate-iodine (*CHI*), the time-reaction of chromic acid (*CA*), the time-reaction of pyrogallic acid (*PA*), the time-reaction of ferric chloride (*FC*), and the time-reaction of Purdy's solution (*PS*). The letter or letters as above given in parentheses each lie at the head of a special column or ordinate, and indicate the agent, while those of the abscissas give the values of the reactions. The letters of the column under *P* indicate, respectively, very

high, high, fair, low and very low; and under *I, GV* and *S,* very dark, dark, fair, light and very light."

The procedure in the examination of the several starches by Dr. Reichert is as follows: The temperature of gelatinization and intensity of color of aniline dyes was determined by placing *a small amount of starch* in a test tube containing in the one case 10 c.c. or an excess of water and in the other case 5 c.c. or an excess of solution of the dye. In using iodine solution he does not say how much starch was employed, but merely states that "the starch was placed on a slide and one or two or more drops of the iodine solution added, the whole covered with a cover slip." In the use of swelling reagents we read that "a small amount of starch is placed on a slide, several drops of the reagent added, a cover glass put on, and the progress of events examined under the microscope." Granting that there is a certain variation to a limited extent in the shade and intensity of color produced by certain reagents with some of the starches,[1] these differences will only hold when definite quantities of starch and definite quantities of reagent are used. From the statements in the foregoing paragraph showing the method of making microscopic mounts, it is apparent that Dr. Reichert did not bear in mind this fundamental fact as he did not use definite quantities of starch with definite quantities of reagent. One illustration is sufficient to show the weakness of his technique and the untrustworthiness of his results. Let the worker make four mounts, using varying quantities of starch and iodine solutions as follows: (1) 0.003 gm. of starch and 1 drop of iodine solution; (2) 0.006 gm. of starch and 1 drop of iodine solution; (3) 0.003 gm. of starch and 2 drops of iodine solution; (4) 0.006 gm. of starch and 2 drops of iodine solution. If a solution be employed containing 0.25 per cent. of Lugol's solution as adopted by Dr. Reichert, the intensity of color will not be as pronounced as if a reagent containing 0.50 per cent. of Lugol's solution be used. In any case the reactions in the several mounts will show considerable variation, a more intense blue coloration being usually discernible in mounts containing 0.003 gm. of starch and 2 drops of reagent and weakest in mounts containing 0.006 gm. of starch and 1 drop of reagent. Nearly equally as striking differences will be obtained when using varying quantities of starch with two or more drops of the swelling reagents employed by Dr. Reichert. A more noticeable and complete swelling being produced when less starch (0.006 gm.) is employed, with an excess of reagent (4 drops), and a partial or incomplete gelatinization always being observable when an excess of starch (0.012 gm.) are used with a minimum quantity (2 drops) of the swelling agent. When we consider the nature of starch these varying results are to be expected unless a quantitative relation be borne in mind between the amount of starch and the number of drops of reagent employed.

The method employed by Dr. Reichert in determiuing the temperature of gelatinization and of coloration with aniline dyes might have been applied to the use of other reagents. In the designation of intensity of color reaction with aniline dyes and iodine, Dr. Reichert was unfortunate in adopting an arbitrary scale of very dark, dark, fair, light and very light, as hardly any two observers would agree as to whether a color was dark or fair, etc. It would have been a great deal better had there been an accurate color scale embodied in the publication so that Dr. Reichert's work could be confirmed.

In view of these serious criticisms involving a crude technique and one which is liable to give discordant results in the hands of different investigators we must conclude that Reichert's work has added practically nothing to the interesting question of stereoisomerism of the starches, nor can it be considered as a serious contribution to our knowledge of the specificity of starches in relation to genera, species, etc. Apparently it will be very difficult for any one very soon to add anything of a fundamental character or in a comprehensive way to the study of starches and that can be at all compared to the monumental work on "Die

[1] *Bot. Gaz.,* October, 1905.

Stärkekörner" written by Naegeli in 1874. This does not mean that there are not many interesting and important problems connected with the study of the starch grain, but the solution of these can be accomplished only at the hands of the experienced specialist engaged in research or under the direction of a master mind.

HENRY KRAEMER
PHILADELPHIA COLLEGE OF PHARMACY,
March 27, 1915

SPECIAL ARTICLES

THE OSMOTIC PROPERTIES OF DIFFERENT KINDS OF MUSCLE

IN two recent articles[1] I have pointed out that the osmotic properties[2] of the smooth and striated muscle of the frog and of the clam's adductor muscle were strikingly different. Loeb suggests[3] that the differences observed by me might be due to the fact that "the smooth muscle of the stomach . . . can not be obtained in as natural a condition as . . . striped muscle . . . ." Still more recently, in an article published from Loeb's laboratory, v. Körösy[4] has enlarged upon Loeb's suggestion and has described some experiments purporting to uphold it.

The reasons for thinking that the differences in the osmotic behavior of the three types of muscle mentioned above can not be due to any difference in the manner of their preparation seem to me very cogent; they have already been largely given in my articles dealing with the subject. But it has not previously been possible to give them completely or to bring them together into one place, and, in view of the suggestions of Loeb and v. Körösy, it seems worth while to do this now.

The first difficulty which one meets in comparing the reactions of smooth and striated muscle is that cutting across the fibers or removing the "natural surface" does not have the same effect on the two tissues. Striated muscle goes almost immediately into rigor in the neighborhood of a cut across its fibers. This condition is accompanied by acid formation,[5] by swelling, and by the loss of irritability and of the characteristic osmotic properties of the tissue; it spreads gradually from the point of injury to other parts. Cutting across the fibers of smooth muscle causes a contraction which is soon followed by relaxation; there is no tendency toward acid formation, swelling or loss of irritability either in the neighborhood of the cut or in any other portion of the tissue. These facts, which are ignored by Loeb and v. Körösy, are very significant; they suggest at the outset, what is confirmed by all my subsequent work, that the fibers of striated muscle are surrounded by characteristic semi-permeable surfaces, injury to which produces profound changes in the tissue; and that no such surfaces exist in the case of smooth muscle. They are incompatible with the view that the osmotic properties of the tissues are alike. Finally, they show that my preparations of smooth muscle, in spite of the fact that their fibers have been cut, are more nearly comparable to uninjured than to injured preparations of striated muscle.

But one need not stop here. The rigor, etc., produced in the neighborhood of a cut across the fibers of striated muscle spreads only gradually from the injured to the uninjured regions; hence, if the injured area be proportionally small, the preparation will react osmotically for the first hour or so very nearly like an uninjured muscle. If a frog's sartorius be cut across its middle, either half of the muscle will have about the same proportions of "natural surface" and "unnatural surface" as the preparations of frog's stomach muscle used in my experiments. Such a cut sartorius reacts for the first hour in all respects very much like an uninjured sartorius. The strikingly different osmotic reactions characteristic of smooth muscle showed themselves

[1] Meigs, *The Journal of Experimental Zoology*, Vol. 13, p. 497, 1913; *The Journal of Biological Chemistry*, Vol. 17, p. 81, 1914.

[2] By "osmotic properties" I mean those properties of the tissues which determine the characteristic changes of weight undergone by them when immersed in various solutions.

[3] Loeb, SCIENCE, N. S., Vol. 37, p. 430, 1913.

[4] V. Körösy, *Zeitschrift für physiologische Chemie*, Vol. 93, pp. 171 *et seq.*, 1914.

[5] Fletcher and Hopkins, *The Journal of Physiology*, Vol. 35, pp. 261 *et seq.*, 1907.

in my preparations long before the end of the first hour.

Further, the effects of cutting across the fibers or of exposing an "unnatural surface" in smooth muscle may be studied experimentally by comparing the reactions of preparations which have been cut in many places with those of others which have been cut as little as possible. Such experiments show that cutting has no perceptible effect after the first few minutes; for the first few minutes it produces a very slight tendency for the preparation to lose fluid. Examination of the differences in the osmotic reactions of smooth and striated muscle under different circumstances shows that these differences can not be explained as the result either of this or of any other conceivable effect of injury. Smooth muscle, for instance, swells more rapidly than striated muscle in Ringer's solution, but less rapidly in half-strength Ringer; it would be a very extraordinary hypothesis that these opposite differences were both the effects of injury. Still less can the swelling of smooth muscle in solutions of non-electrolytes and the peculiar changes of weight undergone by it in double-strength and half-strength Ringer solution be explained as the result of injury by any one who will take the trouble to make a careful study of these phenomena.

In order to obtain a preparation of striated muscle comparable to my preparations of smooth muscle v. Körösy pared off the surface layers of a frog's gastrocnemius with a razor and used the core which was left. This is, to say the least, a severe test. The gastrocnemius is for the most part composed of short fibers which run diagonally across it and end in the fascia covering its surface. The procedure adopted by v. Körösy would therefore give a surface largely or entirely composed of the cut ends of the muscle fibers. My preparations of stomach muscle were covered on one side by the serosa and on the other by a part of the connective tissue which lies between the muscular and mucous coats of the stomach; these two surfaces made up about nine tenths that of the whole preparation, and were certainly as "natural" as that which is left covering a striated muscle after it is torn away from the skin and from the neighboring muscles.

V. Körösy tried only one experiment which bears on the osmotic differences between the smooth and striated muscle of the frog. He immersed his muscle core in 0.23 M saccharose solution and found that it gained weight fairly rapidly. It is to be presumed that lactic acid was being rapidly produced over the whole surface of v. Körösy's preparation,[6] and it is not surprising, therefore, that it should gain weight in either 0.23 M saccharose solution or in any other solution nearly isosmotic with frog's blood. But, in view of the considerations given above, it can hardly be supposed that this experiment shows that the osmotic properties of smooth and striated muscle are alike.

V. Körösy also immersed his gastrocnemius cores in various hypertonic NaCl solutions, and found that they lost weight in the early stages of their immersion.[7] These results are to be compared with mine on the adductor muscle of the clam, which had already begun to gain weight after five minutes' immersion in a strongly hypertonic NaCl solution.[8] My preparation was certainly not any more injured than v. Körösy's in this case, yet under comparable experimental conditions it gained weight and his lost. I do not understand, therefore, why he thinks that his experiments with the gastrocnemius core indicate that the osmotic properties of the various kinds of muscle under consideration are alike, nor do I understand his remark on page 173, which I take to mean that we need information about the changes of weight undergone by clam's muscle in the early stages of its immersion in hypertonic solutions. We already have detailed information on this point.[9]

[6] Fletcher and Hopkins, *The Journal of Physiology*, Vol. 35, pp. 261 *et seq.*, 1907; Laquer, *Zeitschrift für physiologische Chemie*, Vol. 93, p. 69, 1914.

[7] *Loc. cit.*, pp. 170 and 171 and Table 11.

[8] Meigs, *The Journal of Biological Chemistry*, Vol. 17, Experiment 17, p. 97, 1914.

[9] Meigs, *loc. cit.*, Experiments 3 and 17, pp. 95 and 97.

With regard to v. Körösy's supposition (pp. 172 and 173) that my preparations of frog's stomach muscle were contaminated with acid, I can only say that it is incorrect. I took particular pains to avoid contamination of the muscle with the stomach contents; the preparations were decidedly alkaline to litmus at the beginnings of the experiments and remained so for at least twenty-four hours.

It seems to me that any further attempt to show that the smooth and striated muscle of the frog and the adductor muscle of the clam are all equally subject to the "law of Avogadro-van't Hoff" should be based on experiments on all three kinds of muscle and on careful consideration of the data already at hand, rather than on experiments confined to striated muscle and backed up only by experimentally unfounded suppositions.

EDWARD B. MEIGS

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ON THE TAXONOMY OF THE PROCYONIDÆ

WITHIN recent time I have, through the courtesy of the United States National Museum and the Academy of Natural Sciences of Philadelphia, enjoyed the opportunity of making a comparative study of the skeletons of the procyonine mammals of America, and that of the panda of the Old World. These researches have resulted in the production of a memoir setting forth in full complete and comparative accounts of the osteology of all these species and genera, as well as thorough studies of their several dental armatures. This memoir carries with it thirteen quarto plates, upon which are to be found eighty-seven photographic figures, giving all the skulls and many other bones of the skeletons of these procyonine species, together with the skull of *Ailurus fulgens*. In all cases the figures are given natural size.

As there is usually some little delay in the publication of memoirs of this class, I have thought best to publish here an advance abstract, setting forth some of my findings with respect to this group in the matter of their classification. All descriptive details, as well as the large number of osteological figures of the Procyonidæ, will be available to mammalogists later on—that is, at such time as I can arrange for the publication of this work in its entirety.

As to the panda, I have said: "Judging from the characters presented on the part of its teeth; its skull, with the presence of the alisphenoid canal, and its Asiatic habitat, it is clear that *Ailurus fulgens*, the panda, is but remotely related to such forms as the raccoons, the coatis, or the kinkajous. Wherever it belongs, it does *not* belong in there. Having studied only the teeth and skull of a single individual, I am not prepared to say much in regard to its affinities; but I am of the opinion that it belongs, as a superfamily, Ailuroidea, between the bears and the procyonine forms. Possibly *Ailuropus* may be the connecting type here—that is, with the ursine series.

Apart from their special character differences, which have been given in detail above, the dental formulæ agree in *Bassariscus*, *Nasua* and *Bassaricyon*, while in *Potos* the formula is different. This fact alone is sufficient evidence to convince a mammalogist that the Kinkajous are, at least to this extent, more or less removed from the more typical raccoon group. In *Bassaricyon*, although the formula is the same as in a raccoon, the teeth differ markedly in their special characters. Especially is this the case with respect to their morphology and extremely feeble tuberculation.

In not a few particulars its cranium and mandible agree with that part of the skeleton in *Bassariscus*, though the curvature of the superior cranial line is more as we find it in *Procyon*—that is, in *Bassaricyon* it is not so flat and straight as it is in the ring-tailed bassaris.

Not having examined the entire skeleton, my opinion is given tentatively in so far as the taxonomical position of *Bassaricyon* is concerned; but with the morphology of its teeth and skull before us, it is clear that it possesses characters common to both the true

raccoons as well as to *Bassariscus,* and therefore belongs in some subdivisional group by itself. This is likewise true of *Nasua,* for, although the morphology and characters of its skull, axial skeleton and limbs are procyonine, it nevertheless departs very decidedly from the true raccoons in not a few of its osteological characters. This is seen in the elongate form of the skull in *Nasua* with its relatively smaller bullæ; the mesial foramen between the anterior palatine foramina; the upturned nasals, but more particularly the great differences to be found in the long bones of its skeleton; their proportional lengths and their characters, as well as the difference in form of the scapula and pelvis. These *constant* differences in the skeleton among *Bassariscus, Procyon* and *Nasua* are supergeneric and must be so considered.

Coming to *Potos,* we not only find the radical difference in the dental armature as compared with all the other genera; but its skull, although exhibiting certain general procyonine characters, is, in its form, entirely different from the skull of *Procyon,* or of *Nasua,* or the bassaris, or of *Bassaricyon.* The skull of a kinkajou is as short as the skull in a domestic cat; the mastoid process is entirely aborted; the paroccipital stands away from the bulla on the same side; tympanics short; frontal sinuses extremely small; and in the mandible the complete coossification of the horizontal rami at the symphysis, with the lower border of the bone concave. There are likewise numerous differences in the axial skeleton which have been fully enumerated above. In short, *Potos,* with its short skull; prehensile tail; different vertebral column; and other departures in its skeleton from the more closely related genera noted above, belongs strictly in a group by itself—that is, the several species do, and, while evidently procyonine in its characters and relationships, it is nevertheless well removed from the more typical raccoons, and the further we study its habits and anatomy, the more evident does this fact become.

In short, this group of mammals constitutes a superfamily PROCYONOIDEA, divisible into two families—the Procyonidæ and the Potosidæ, with the former family divided into three subfamilies, Bassarisinæ, Bassaricyoninæ and Nasuinæ, thus:

Superfamily	Families	Subfamilies
PROCYONOIDEA	Procyonidæ	Bassarisinæ
		Bassaricyoninæ
		Nasuinæ
	Potosidæ	Protosinæ

and this I believe to be their true relationships in nature.

R. W. SHUFELDT

WASHINGTON, D. C.,
December 24, 1914

THE NATIONAL ACADEMY OF SCIENCES

THE sessions of the annual meeting of the academy were held in the Oak Room of the Raleigh Hotel and in the United States National Museum, Washington, D. C., on April 19, 20 and 21, 1915.

Sixty-one members were present, as follows: Abel, Becker, Bell, Boltwood, Britton, Bumstead, Cattell, Chamberlin, Chittenden, Clark (W. B.), Clarke (F. W.), Clarke (J. M.), Conklin, Coulter, Cross, Dall, Davenport, Davis, Day, Donaldson, Fewkes, Frost, Hague, Hale, Harper, Harrison, Hayford, Hillebrand, Holmes, Howell, Jennings, Loeb, Mall, Meltzer, Mendel, Merriam, Michelson, Moore, Morgan, Morley, Nichols (E. L.), Noyes (A. A.), Noyes (W. A.), Osborn (H. F.), Osborne (T. B.), Parker, Pickering, Pirsson, Ransome, Reid, Remsen, Schuchert, Scott, Smith (Erwin F.), Walcott, Webster, Welch, Wheeler, White, Wood (R. W.), Woodward.

The following scientific program was carried out in full:

"Localization of the Hereditary Material in Germ Cells," by Thomas H. Morgan.

Problems of Nutrition and Growth:

"Stimulation of Growth," by Jacques Loeb.

"Specific Chemical Aspects of Growth," by Lafayette B. Mendel.

"Basal Metabolism during the Period of Growth," by Eugene F. Du Bois, medical director, Russell Sage Institute of Pathology (by invitation of the Program Committee).

"Retention in the Circulation of Injected Dextrose in Depancreatized Animals and the Effect of an Intravenous Injection of an Emulsion of Pancreas upon this Retention," by I. S. Kleiner and S. J. Meltzer.

"The Electrical Photometry of Stars," by Joel Stebbins, Draper Medallist.

"A Vortex Hypothesis of Sun Spots," by George E. Hale.

"The Spectroscopic Binary, Mu Orionis," by Edwin B. Frost.

"One-Dimensional Gases and the Experimental Determination of the Law of Reflection for Gas Molecules," by Robert W. Wood.

"The Relations Between Resonance and Absorption Spectra," by Robert W. Wood.

"On the Polarized Fluorescence of Ammonio-Uranyl Chloride," by Edward L. Nichols and H. L. Howes.

"Atomism in Modern Physics," by Robert A. Millikan (by invitation of the Program Committee).

"Problems Associated with the Origin of Coral Reefs, Suggested by a Shaler Memorial Study of the Reefs of Fiji, New Caledonia, Loyalty Islands, New Hebrides, Queensland and the Society Islands, in 1914," by William Morris Davis.

"Inorganic Constituents of Marine Invertebrates," by F. W. Clarke.

"Amphibia and Reptilia of the American Carboniferous," by Roy L. Moodie (introduced by H. F. Osborn).

"Human Races of the Old Stone Age of Europe, the Geologic Time of their Appearance, their Racial and Anatomical Characters," by Henry Fairfield Osborn and J. Howard McGregor.

"On the Fossil Algæ of the Petroleum-yielding Shales of the Green River Formation," by Charles A. Davis, geologist, Bureau of Mines (by invitation of the Program Committee).

"The Forests of Porto Rico," by Nathaniel L. Britton.

"Pictures on Prehistoric Pottery from the Mimbres Valley in New Mexico and their Relation to those of Casas Grandes," by J. Walter Fewkes.

"Inheritance of Temperament," by Charles B. Davenport.

"Inheritance of Huntington's Chorea," by Charles B. Davenport.

"The Fur Seal Herd of the Pribilof Islands," by George H. Parker, official representative of the academy upon the Special Commission appointed by the President of the United States to study and report upon the Alaskan Fur Seals during the summer of 1914.

"The Evolution of the Earth," by Thomas Chrowder Chamberlin, of the University of Chicago, William Ellery Hale lecturer.

The president announced that the preparation of biographical memoirs of deceased members had been assigned as follows:

Bowditch, Henry P.	Cannon, Walter B.
Davidson, George	Existing biography approved.
Gould, B. A.	Comstock, George C.
Mitchell, Henry	Hayford, John F.
Mitchell, Silas Wier	Welch, William H.
Chandler, Seth Carlo	Elkin, William L.
Peirce, Benjamin Osgood.	Hall, E. H.
Holden, Edw. Singleton.	Campbell, W. W.
Hill, George William	Brown, E. W.
Gill, Theodore Nicholas.	Dall, William H.
Minot, Charles Sedgwick.	Donaldson, Henry H.
Billings, John S.	Garrison, Fielding H.

The president announced the death since the autumn meeting of one foreign associate:

Auwers, G. F. J. Arthur, January 24, 1915, elected 1883.

Reports of the President and Treasurer

The reports of the president[1] and treasurer[2] for 1914 as transmitted to the senate of the United States by the president of the academy were presented in their printed form and approved.

Report of the Home Secretary

THE PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES:

Sir: I have the honor to present the annual report of home secretary of the National Academy of Sciences for the year ending April 21, 1915.

The memoir of the National Academy of Sciences, Volume 12, Part 1, and bearing the title, "Monograph of the Bombycine Moths of North America," by A. S. Packard, edited by T. D. A. Cockerell, has been published and distributed to the members, foreign associates, institutions and reference libraries; Volume 12, Part 3, of the *Memoirs,* entitled "The Turquoise," by Joseph E. Pogue, has also been published and distributed to the members; Part 2 of this same volume entitled, "Variations and Ecological Distribution of the Snails of the Genus *Io,*" by Charles C. Adams, has received final consideration, and is now waiting to be bound at the Government Printing Office; the memoir forming Volume 13, being "A Catalogue of the Meteorites of North America," by Oliver C. Farrington, only awaits press work and binding before it is issued.

The biographical memoirs of John Wesley Powell, Charles A. Schott and Miers Fisher Longstreth have been published. The publication of the memoir of J. Peter Lesley, by Dr. William M. Davis, has been approved by the committee on publication, and the biography of Henry Morton,

[1] Report of the National Academy of Sciences for the year 1914, pp. 11–56.

[2] *Idem,* pp. 57–65.

by Edward L. Nichols, has been printed and awaits the portrait.

Three members have died since the last annual meeting: Theodore Nicholas Gill, on September 25, 1914, elected in 1873; Charles Sedgwick Minot, on November 19, 1914, elected in 1897, and Henry Lord Wheeler, on October 30, 1914, elected in 1909.

Of our foreign associates, Eduard Suess died on April 26, 1914, elected in 1898; August Weismann, on November 5, 1914, elected in 1913; Hugo Kronecker, on June 6, 1914, elected in 1901; G. F. J. Arthur Auwers, on January 24, 1915, elected in 1883.

There are 134 active members on the membership list, 1 honorary member, and 43 foreign associates.

Arthur L. Day,
Home Secretary

Report of the Directors of the Bache Fund

To the President of the National Academy of Sciences:

Sir: The serious illness of Dr. Charles S. Minot, the chairman of the board of directors of the Bache Fund, made it difficult to carry on the work of the board for several months. His death in November last left a vacancy hard to fill, as he was most conscientious in the performance of his duties. After careful consideration the two remaining members of the board elected Professor Ross G. Harrison the third member and he accepted. In turn the board elected the undersigned chairman.

Since the last annual meeting of the academy the following appropriations have been made:

No. 182, W. C. Kendall, $600. April 30, 1914. Toward the expenses of illustrations in color and incidental expenses in connection with part II. (Salmonidæ), fishes of New England, to be published by the Boston Society of Natural History.

No. 183. C. G. Abbot, $250. June 29, 1914. To complete and test on Mt. Wilson in California an apparatus consisting of a concave cylindric mirror of about 100 sq. ft. surface adapted to heat oil to circulate through a reservoir containing ovens and water pipes, and thereby to utilize solar radiation for cooking and for heating water for domestic purposes.

No. 184. P. W. Bridgman, $500. September 14, 1914. To continue the work on high pressures, especially to investigate the phase changes brought about in various substances by very high pressure.

No. 185. Robert W. Hegner, $160. December 26, 1914. To determine the visible changes that take place during the differentiation of the germ cells in the embryos of hermaphroditic animals, and to discover, if possible, the cause of these changes.

No. 186. J. Voûte. $800. February 9, 1915. For the determination of parallaxes of southern stars by transits. The Bache Fund has heretofore granted $1,000 for this research. It is conducted at the Royal Observatory, Cape of Good Hope, wholly at the expense of Mr. Voûte, except for these grants.

No. 187. H. H. Lane, $500. April 14, 1915. To make a comparative study of the embryos and young of various mammals in order to determine, by physiological experimentation and morphological observations, the correlation between structure and function in the development of the special senses.

Ira Remsen,
Chairman

April, 1915

Report of the Trustees of the Watson Fund

The will of the late James Craig Watson provided "for the promotion of astronomical science," but he expressed the wish that a medal should be given and that tables should be prepared of the motions of all the planets discovered by him. This last wish has now been carried out in a most satisfactory manner by Professor A. O. Leuschner, so that the income which has been used for this purpose during the last fourteen years is now available for the promotion of astronomical science in other directions.

The undersigned accordingly recommend the following votes:

Resolved, That the sum of five hundred dollars from the income of the Watson Fund be appropriated to Professor John A. Miller, director of the Sproul Observatory, for measuring plates already taken for the determination of stellar parallaxes.

Resolved, That the sum of three hundred dollars be appropriated from the income of the Watson Fund to Mr. John E. Mellish, to enable him to undertake observations at the Yerkes Observatory.

E. C. Pickering, *Chairman,*
W. L. Elkin,
Edwin B. Frost

April 2, 1915

Report of the Committee on the Henry Draper Fund

The committee unanimously recommends to the academy that the following grants for research be approved:

Five hundred dollars to Dr. W. W. Campbell, director of the Lick Observatory, for the purchase and construction of spectrographic and other apparatus for use with the Crossley Reflector.

Two hundred and fifty dollars to Dr. S. A. Mitchell, director of the Leander McCormick Observatory, for the purchase of a machine for measuring astronomical photographs.

George E. Hale,
Chairman

Report of the Committee on the J. Lawrence Smith Fund

TO THE NATIONAL ACADEMY OF SCIENCES:

In regard to researches now in progress or lately completed which have received aid from this fund the committee reports as follows:

Grant No. 3. Edmund Otis Hovey, curator in geology and paleontology in the American Museum of Natural History, New York, received in 1910 a grant of $400 in aid of the study of certain meteorites. Metallographic and chemical examinations are in progress. Dr. Hovey is at this time out of the country.

Grant No. 4. Professor C. C. Trowbridge, of the department of physics in Columbia University, received in 1910 a grant of $400 in aid of his study of the luminous trains of meteors. The academy has also made further grants of $250 in 1912, of $250 in 1913, and of $250 in 1914. The important work of collecting, verifying and tabulating records of observations of luminous trains has been diligently pursued. Lately, the collection and preparation for publication of drawings of luminous trains has been undertaken. In accordance with the vote of the academy in 1912, three payments have been made from this grant and it is expected that the fourth and last installment will be required during the current year.

Grant No. 5. Dr. George P. Merrill, curator in the department of geology in the United States National Museum, received a grant of $200 in 1910, and of $200 in 1911, to aid in the study of the occurrence of certain elements suspected to be present in small quantities in some meteorites. This work has been successfully completed, and the final report is ready for submission to the academy; the report contains a tabulation of all available trustworthy analyses of meteorites, and is accompanied by a special paper on the occurrence in meteorites of francolite or some allied phosphatic mineral in place of the apatite of terrestrial rocks.

The cash balance of income now available for grants is $874.87, and the invested income is $1,532.50.

EDWARD W. MORLEY,
Chairman

Professor S. A. Mitchell, University of Virginia, has applied for a grant of $500 to aid in the computation of orbits of meteors. Dr. Charles P. Olivier, president of the American Meteor Society, has computed orbits from some nine thousand observations of meteor paths, and has some thousand observations awaiting reduction. He has published two important papers containing several hundred computed orbits. The committee recommend the grant of $500 to Professor S. A. Mitchell, to aid in computations of orbits of meteors.

EDWARD W. MORLEY,
Chairman

The following motion was presented:

That the Committee on the J. Lawrence Smith Fund recommend that the meteorites remaining from the purchases by Dr. Merrill be deposited by the National Academy of Sciences in the United States National Museum.

Report of the Board of Directors of the Benjamin Apthorp Gould Fund

The income balance of the Gould Fund is now, in cash, four hundred and four dollars and sixty-four cents ($404.64); in readily negotiable securities, four thousand and fifty-seven dollars and fifty cents ($4,057.50), and in an unpaid grant to the *Astronomical Journal*, one thousand dollars ($1,000).

F. R. MOULTON,
E. E. BARNARD

Report of the Directors of the Wolcott Gibbs Fund

The trustees of the Wolcott Gibbs Fund for Chemical Research have the honor to present their annual report to the National Academy of Sciences. Since the last report three grants have been made from the income of the Fund as follows:

III. One hundred dollars to Professor W. J. Hale, Ann Arbor, to pay for assistance in a research on derivatives of 2.3-diacetylpentadiene, voted May 15, 1914.

Professor Hale reports that he has prepared the cyclopentadiopyridazine and the corresponding phenyl compound, and determined their composition. He hopes to finish the research before the summer vacation.

IV. Two hundred dollars to Professor W. D. Haskins, University of Chicago, for making a special potentiometer and galvanometer to study cobaltammines and ternary systems of fused salts. Voted November 25, 1914.

Professor Haskins reports that a beginning has been made on the work in spite of his severe sickness and the fact that the war has prevented him from obtaining part of the apparatus from Germany.

V. A second grant of one hundred dollars to Professor Mary E. Holmes, of Mount Holyoke College, for assistance in her work on the electrolytic determination of cadmium. Voted March 18, 1915.

Professor Holmes reports that she has purchased platinum electrodes of a new form, and with these has studied the deposition of cadmium and copper, so that she is now beginning to study the electrical separation of cadmium from other metals.

The unexpended income of the fund amounted on April first to $111.99.

C. L. JACKSON,
Chairman

Report of the Committee on Solar Research

The committee begs to call the attention of the academy to the publication of Vol. IV. of the *Transactions* of the International Union for Co-operation in Solar Research, which contains the complete proceedings of the last meeting in Bonn, reports of the various committees, resolutions adopted by the Union, and several scientific papers on solar and stellar phenomena.

The four volumes of *Transactions* already published by the Solar Union may be obtained from Messrs. Longmans, Green & Company, Fourth Avenue and 30th Street, New York, at $2.50 per volume.

George E. Hale,
Chairman

Recommendations from the Council

That the following bequest from Mrs. Mary Anna Palmer Draper be accepted.

Extract from the Will of Mrs. Mary Anna Palmer Draper, Page 7, Section 9 (Second Paragraph): "I give and bequeath to the National Academy of Sciences, Smithsonian Institution, Washington, D. C., the sum of twenty-five thousand dollars ($25,000)."

Report of the Editorial Board of the Proceedings

The editorial board of the *Proceedings* reports to the academy that four numbers of the *Proceedings* have now been issued, containing sixty-seven original papers in addition to the report of the autumn meeting, notices of scientific memoirs, and announcements. These numbers have consisted of 258 pages, an average of 64 pages per number and of about four pages per article. The papers are distributed among different sciences as follows: mathematics, 11; astronomy, 11; physics, none; chemistry, 11; geology, 2; paleontology, 1; botany, 4; zoology (including genetics), 12; physiology, 8; pathology, none; anthropology, 5; psychology, 2. It will be noticed that the subjects of physics, of geology and paleontology, and of pathology, have been very inadequately represented; and the editorial board urges members of the academy in these fields to endeavor to remedy this situation.

An edition of 3,000 copies of these four numbers has been printed. Of this edition about 900 are to be sent abroad to the libraries of universities and other active research institutions upon a mailing list prepared with great care by the foreign secretary aided by members of the editorial board. Of this edition 1,200 copies have also been distributed in this country by the home secretary to important libraries and to the thousand persons whose names are starred in Cattell's American Men of Science.

Arthur A. Noyes,
Chairman

Report of the Committee on the Collection of Historical Portraits, Manuscripts and Instruments

To the President and Members of the National Academy of Sciences:

Your committee on the collection of historical portraits, manuscripts and instruments, including instruments purchased at the expense of the trust funds which are no longer needed for the original purpose, begs to report as follows:

That the collection of portraits of the members of the academy has been brought together and arranged alphabetically.

That the foreign secretary has turned over the medal from the Groningen Academy celebrating its four hundredth anniversary.

That the following apparatus was presented by Mrs. Henry Draper and has been deposited in the United States National Museum:

1 slit.
1 spectrum photograph (broken).
1 liquid prism cell.
1 prism with 2-inch faces.
1 bundle—attempts of Henry Draper to rule gratings.
1 speculum metal ruled surface; 2-inch, square.
1 bunsen burner.
2 boxes, 12 photographs each.
1 box, 50 photographs.
1 box, 34 photographs.
1 box, 22 photographs.
1 box, 15 daguerreotypes.
1 box, 7 photographs.
13 Geisler tubes.

Election of Members of the Council

Mr. W. H. Howell and Mr. J. M. Coulter were chosen to succeed Mr. W. T. Councilman and Mr. R. S. Woodward.

Election of New Members

Henry Seely White, mathematician, Vassar College, Poughkeepsie, N. Y.

Charles Greeley Abbot, astrophysicist, Astrophysical Observatory, Smithsonian Institution, Washington, D. C.

Robert Andrews Millikan, physicist, University of Chicago, Chicago, Ill.

Alexander Smith, chemist, Columbia University, New York City.

Samuel Wendell Williston, paleontologist, University of Chicago, Chicago, Ill.

William Ernest Castle, zoologist, Harvard University, Cambridge, Mass.

Frank Rattray Lillie, zoologist, University of Chicago, Chicago, Ill.

Graham Lusk, physiologist, Cornell University Medical College, New York City.

Victor Clarence Vaughan, pathologist, University of Michigan, Ann Arbor, Michigan.

Granville Stanley Hall, psychologist, Clark University, Worcester, Mass.

An amendment to the constitution was adopted which permits the admission of 15 members annually in future.

ARTHUR L. DAY,
Home Secretary

NEW ORLEANS MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE fiftieth meeting of the American Chemical Society was held in New Orleans, Louisiana, March 31 to April 3, 1915. For the most part, the members reached New Orleans during the morning of March 31 and spent some hours in viewing the unique attractions of the city. At 4:30 P.M., two hundred and fifty members and guests boarded a steamer for a trip down the Mississippi River, the usual complimentary smoker being held on the boat. The smoker was one of unusual attractions, the long cabin of the boat being festooned with Spanish moss and laurel and various southern evergreens, making a very attractive scene. The evening was enlivened by music from two orchestras and a vaudeville troupe. The boat returned to New Orleans in time for the council meeting, held at ten o'clock P.M. at the Hotel Grunewald. On Thursday morning, April 1, after addresses of welcome by Hon. Martin Behrman, mayor of New Orleans, and President Robert Sharp of Tulane University, and an appropriate response from President Charles H. Herty of the society, the general meeting was called to order. Professor Alfred Werner, of the University of Zurich, having been duly nominated and having received a majority vote of the council, was elected to honorary membership in the society. The meeting then listened to an address by A. D. Little on "The Industrial Resources and Opportunities of the South." Following this address, the Industrial Division held a public symposium throughout the day, presenting the following papers, all of which, with the exception of the paper by H. A. Huston, have been printed in the April, 1915, issue of the *Journal of Industrial and Engineering Chemistry*.

Contributions of the Chemist to the Wine Industry: Charles S. Ash, consulting chemist.

Contributions of the Chemist to the Copper Industry: J. B. F. Herreshoff, vice-president Nichols Copper Company and consulting engineer General Chemical Company.

Contributions of the Chemist to the Corn Products Industry: E. T. Bedford, president Corn Products Refining Company.

Contributions of the Chemist to the Asphalt Industry: James Lewis Rake, secretary The Barber Asphalt Paving Company.

Contributions of the Chemist to the Cotton-seed Oil Industry: David Wesson, manager of the Technical Department, Southern Cotton Oil Company.

Contributions of the Chemist to the Cement Industry: G. S. Brown, president Alpha Portland Cement Company.

Contributions of the Chemist to the Sugar Industry: W. D. Horne, consulting chemist.

Contributions of the Chemist to the Incandescent Gas Mantle Industry: Sidney Mason, president of the Welsbach Company.

Contributions of the Chemist to the Textile Industry: Franklin W. Hobbs, President Arlington Mills, and Past President American Cotton Manufacturers' Association.

Contributions of the Chemist to the Fertilizer Industry: H. Walker Wallace, Manager General Sales Department, Virginia-Carolina Chemical Company.

Contributions of the Chemist to the Soda Industry: F. R. Hazard, President of the Solvay Process Company.

Contributions of the Chemist to the Leather Industry: William H. Teas, President Marion Extract Company.

Contributions of the Chemist to the Flour Industry: John A. Wesener and George L. Teller, Consulting Chemists.

Contributions of the Chemist to the Brewing Industry: Gaston D. Thevenot, Consulting Chemist.

Contributions of the Chemist to the Preserved Foods Industry: R. I. Bentley, Vice-president and General Manager California Fruit Canners' Association.

Contributions of the Chemist to the Potable Water Industry: Wm. P. Mason, Professor of Chemistry, Rensselaer Polytechnic Institute.

Contributions of the Chemist to the Celluloid and Nitro-cellulose Industry: R. C. Schupphaus, Consulting Chemist.

Contributions of the Chemist to the Glass Industry: A. A. Houghton, Vice-President Corning Glass Works.

Contributions of the Chemist to the Pulp and Paper Industry: F. L. Moore, president American Paper and Pulp Association.

The Strassfurt Potash Industry: H. A. Huston.

A complimentary luncheon was served at the Tulane refectory, the university being host. On Thursday evening a public address to the people of New Orleans by Bernhard C. Hesse, entitled "The Chemists' Contribution to the Industrial Development of the United States—A Record of Achievement," was given at the Hotel Grunewald, a large attendance being present. On Friday divisional meetings were held, before which one hundred and fifty-three papers were presented. The details of these papers and a further description of the meetings will be found in the May issue of the *Journal of Industrial and Engineering Chemistry*. Friday evening a subscription dinner was held at the Restaurant de la Louisiane, which will long be remembered by those present for the charming company and the creole cuisine. On Saturday one hundred of the members took a special train to Weeks Island and visited the famous salt-mine of the Myles Salt Co. The train went through the bayou region of Louisiana, made famous by Longfellow's poem, "Evangeline." The newly planted sugar-fields and the swamps, with their Spanish moss and the early tropical herbage, were attractive to all. The mine, which is an unusual one, was entered by a shaft six hundred feet deep, the bottom of which opened into galleries cut in solid salt many hundred feet long and eighty-five feet high by eighty-five feet wide, entirely unsupported by timbers. The salt, approximately 99.9 per cent. pure, is simply blasted out, carried to the surface, screened to various sizes, and placed on the market. The party returned to New Orleans in time to catch the evening trains. Many ladies were present at the meeting and, under the charge of the committee of which Mrs. E. J. Northrup was chairman, received many attentions from the people of New Orleans.

The ladies were present at the smoker and at the banquet and took the salt-mine excursion and were given a special trip through the Vieux Carre and to the Newcomb Pottery, and they had a dinner of their own at one of the famous local restaurants. One hundred and seventy-five members and approximately one hundred and twenty-five guests were present, so that the meeting was a very successful one from the point of numbers, considering the distance of New Orleans from the chemical center of the country. Meetings of the following divisions were held, full programs of which will appear in the May issue of the *Journal of Industrial and Engineering Chemistry*:

Industrial Chemists and Chemical Engineers.—H. E. Howe, in the absence of the chairman, was in charge. The following committees were appointed:

Committee on Standard Specifications and Methods of Analysis: (Chairman not appointed), A. M. Comey, J. O. Handy, Robert Job, F. G. Stantial.

Committee on Non-ferrous Metals and Alloys, a subcommittee of the committee on standard specifications: Wm. Price, chairman, Allen Merrill, Geo. L. Heath, Gilbert Rigg, Bruno Woichiechewski.

Committee on Soap Products: Archibald Campbell, chairman, C. P. Long, J. R. Powell, Percy H. Walker.

Committee on Glycerine, a subcommittee of the Committee on Soap Products: A. C. Langmuir, chairman, W. H. Low, S. S. Emery, R. E. Devine, J. W. Loveland, A. M. Comey.

Committee on Naval Stores: J. E. Teeple, chairman (other members not yet selected).

Committee on Alum: W. M. Booth, chairman, Chas. P. Hoover, Wm. C. Carnell.

Committee on Platinum: W. F. Hillebrand, chairman, Percy H. Walker, H. T. Allen.

Physical and Inorganic Chemistry.—E. P. Schoch, in the absence of the chairman, was in charge.

Fertilizer Chemistry.—Chairman J. E. Breckenridge was in charge.

Agricultural and Food Chemistry.—Chairman Floyd W. Robison was in charge.

Organic Chemistry.—C. G. Derick, in the absence of the chairman, was in charge.

Pharmaceutical Chemistry.—Chairman F. R. Eldred was in charge.

Biological Chemistry.—Chairman C. L. Alsberg was in charge.

Water, Sewage and Sanitation.—The following officers were elected: Edward Bartow, chairman; E. B. Phelps, vice-chairman; H. P. Corson, secretary; executive committee—the officers and C. P. Hoover and E. H. S. Bailey.

Charles L. Parsons,
Secretary

THE AMERICAN MATHEMATICAL SOCIETY

The one hundred and seventy-seventh regular meeting of the society was held at Columbia University on Saturday, April 24, seventy-one mem-

bers being in attendance at the two sessions. President E. W. Brown occupied the chair, being relieved by ex-presidents Osgood, Moore and White and Vice-president Veblen. The following were elected to membership in the society: Professor L. S. Hill, University of Montana; Miss G. I McCain, Indiana University; Mr. J. L. Riley, Rice Institute. Eleven applications for membership were received.

The invitation of Harvard University to hold the summer meeting and colloquium of the society at Harvard in 1916 was accepted. The annual meeting will be held in New York City in December. Committees were appointed to arrange for these meetings and to present a list of nominations for officers for 1916. Professor P. F. Smith was reelected a member of the editorial committee of the *Transactions*.

Reports of the committees were received regarding the movement against mathematics in the schools and the possible relations of the society to the field now covered by the *American Mathematical Monthly*. It was decided that in the former matter no action of the society was at present advisable. The relations of the society to the field covered by the *Monthly* were carefully considered and the sense of the Council was embodied in the following resolution: "It is deemed unwise for the American Mathematical Society to enter into the activities of the special field now covered by the *American Mathematical Monthly;* but the council desires to express its realization of the importance of the work in this field and its value to mathematical science, and to say that should an organization be formed to deal specifically with this work, the society would entertain toward such an organization only feelings of hearty goodwill and encouragement."

The following papers were read at this meeting:

C. J. de la Vallée-Poussin: "Démonstration simplifiée d'un théorème de Vitali sur le passage à la limite sous le signe d'intégration."

C. A. Fischer: "Minima of double integrals with respect to one-sided variations."

G. M. Green: "Nets of space curves."

R. L. Moore: "A set of axioms in terms of point, region and motion."

R. L. Moore: "On the categoricity of a set of postulates."

H. S. Vandiver: "A property of cyclotomic integers and its relation to Fermat's last theorem. Second paper."

J. F. Ritt: "The reduction of invariant equations."

E. B. Wilson: "Linear momentum, kinetic energy and angular momentum."

F. H. Safford: "An irrational transformation of the Weierstrass $\wp$-function curves."

Arnold Emch: "A certain class of functions connected with Fuchsian groups."

G. D. Birkhoff: "An elementary double inequality for the root of an algebraic equation having greatest absolute value."

H. S. White and Louise D. Cummings: "Groupless triad systems on 15 elements."

Edward Kasner: "Conformal geometry in the complex domain."

Edward Kasner: "Convergence proofs connected with equilong invariants."

E. V. Huntington: "Notes on the catenary, including the case of an extensible chain."

R. C. Strachan: "Note on the catenary."

J. E. Rowe: "A property of the osculant conic of the rational cubic."

J. E. Rowe: "The node of the rational cubic as a rational curve in lines."

Dr. F. W. Beal: "A congruence of circles."

H. F. Stecker: "Linear integral equations whose solutions have only a finite number of terms."

C. A. Epperson: "Note on Green's theorem."

L. J. Reed: "Some fundamental systems of formal modular invariants and covariants."

J. R. Kline: "Double elliptic geometry in terms of point and order."

Alexander Pell: "On the curves of constant torsion."

J. W. Young and F. M. Morgan: "The geometries associated with a certain system of Cremona groups."

T. H. Gronwall: "A functional equation in the kinetic theory of gases."

J. W. Alexander, II: "A theorem on conformal representation."

J. H. Weaver: "The Collection of Pappus."

A meeting of the society was held in Chicago on April 2–3. The summer meeting will be held at the University of California and Stanford University, August 3–5.

F. N. COLE,
Secretary

SOCIETIES AND ACADEMIES

THE UTAH ACADEMY OF SCIENCES

THE eighth annual convention of the Utah Academy of Sciences was held in the chemistry lecture room of the University of Utah. Three sessions were held: one at eight P.M., Friday, April 2, one at 10 A.M., Saturday, April 3, and the closing meeting at two P.M., the same day.

President Marcus E. Jones occupied the chair at all the sessions.

Professor Byron Cummings, U. U., Dr. W. E. Carroll, U. A. C. and Dr. Helen I. Mattill, U. U., were elected to fellowships, and Isaac Diehl (Robinson, Utah), H. J. Maughan, U. A. C., Miss Mary Morehead, U. U., James R. Smith (Heber City), and Chas. E. Mau, B. Y. U., to membership in the academy.

The officers for the ensuing year are as follows:

President—Dr. Harvey Fletcher, B. Y. U., Provo.

First Vice-president—Dr. Frank Harris, U. A. C., Logan.

Second Vice-president—Dr. L. L. Daines, B. Y. U., Logan.

Permanent Secretary-treasurer—A. O. Garrett, Salt Lake High School.

Councillors—Professor J. L. Gibson, U. U., W. D. Neal, Salt Lake City, Dr. W. E. Carroll, U. A. C., Logan.

A committee was appointed to make arrangements for publication of the proceedings of the academy.

The following papers and lectures were presented:

"The Rights and Duties of the Scientist," by Professor Marcus E. Jones.

"The Textile Fabrics of the Cliff Dwellers," by Professor Byron Cummings, U. U. (Illustrated by numerous specimens taken from cliff dwellings.)

"Controlling Grasshoppers," by Dr. E. D. Ball, U. A. C.

"Effect of Soil Alkali on Plant Growth," by Dr. Frank Harris, U. A. C.

"Some Unique Rusts," by A. O. Garrett, Salt Lake High School.

"Effect of the Amount of Protein Consumed upon the Digestion and Protein Metabolism in Lambs and upon the Composition of their Flesh and Blood," by Dr. W. E. Carroll, U. A. C.

"A Determination of Avogadro's Constant *N*," by Dr. Harvey Fletcher, B. Y. U.

"The Voice Tonascope," by Dr. Franklin O. Smith, U. U.

"The Origin of Higher Orders of Difference Tones: Experimental," by Dr. Joseph Peterson, U. U.

"The Hot Air Furnace—A Study of Combustion," by Dr. W. C. Ebaugh, U. U.

"Color Photography," by Dr. Chas. T. Vorhies, U. U., and Professor Marcus E. Jones. (Illustrated by lantern projections of numerous color photographs taken independently by Dr. Vorhies and Professor Jones in Big Cottonwood Canyon and other parts of Utah.)

A. O. Garrett,
Secretary

The Anthropological Society of Washington

At the 482d meeting of the society, held February 2, 1915, Dr. C. L. G. Anderson read an obituary on Dr. A. F. A. King, who died in Washington, December 13, 1914. Born in England in 1841 and coming to Virginia in boyhood, he graduated in medicine, both at Washington and at Philadelphia. Soon after the Civil War he served as surgeon at the Lincoln Hospital. From 1870 until his death he held medical chairs in Washington and the University of Vermont and made many contributions to medical and scientific literature. Among his anthropological papers was one on "The Evolution of Marriage Ceremony and its Import."

At the 483d meeting of the society, held February 16, 1915, a paper was read by Mr. William H. Babcock on "The Races of Britain." Three native languages have been spoken in parts of Great Britain since the sixth century. They represent three waves of invasion by blond peoples. The dark admixture in Britain comes from an earlier population, a fairly advanced neolithic race, probably from southern Europe, which perhaps had absorbed paleolithic remnants found in the island. Reports were made on several recent scientific trips. Professor W. H. Holmes and Dr. Aleš Hrdlička installed exhibits in Indian ethnology and physical anthropology for the Panama-California Exposition. These are new and very important and will form parts of permanent museums. Dr. J. W. Fewkes proved prehistoric cultural interchanges between Mexico and our southwest in the ruins of the valleys of the Santa Cruz in Arizona and of the Mimbres in New Mexico. The former are of the Casa Grande type. More than 800 specimens were brought back, including 250 of painted pottery. Dr. Truman Michelson found scarcely a dozen of the 600 Stockbridges now in Wisconsin who remember a few Stockbridge words. The language was definitely placed in the Pequot-Mohegan and Natick division of central Algonquian dialects, although related to the Delaware-Munsee. Among the Brothertowns near Lake Winnebago, not one was found who remembered Brothertown words. Mr. J. N. B. Hewitt found on his trip to Canada only one survivor who remembered anything of the Nanticoke dialect. He also studied the place of song in the ceremonial of an Iroquois lodge.

Daniel Folkmar,
Secretary